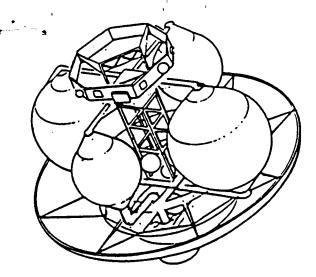
# Appendix A toVolume IV

#### **Orbital Transfer Vehicle** System Analysis Study **Concept Definition And**

Accommodations

Space Station



(NASA-CR-179294) OBBITAL TRABSFER VEHICLE CONCEPT DEPINITION AND SYSTEM ANALYSIS STUDY. VOLUME 4, APPENDIX A: SPACE STATION ACCOMMODATIONS. BEVISION 1 Final Report, Jul. 1984 - Oct. 1985 (Martin Marietta

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MCR-86-2601 NAS8-36108

### **CONCEPT DEFINITION AND SYSTEM ANALYSIS STUDY ORBITAL TRANSFER VEHICLE**

APPENDIX A TO VOLUME IV SPACE STATION ACCOMMODATIONS

August 1985 Rev 1 - July 1987

Prepared By:

Acommodations Manager

Approved By: WILL ALLUM
J.T. Keeley
Program Manager
Initial Phase

### MARTIN MARIETTA

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### INTRODUCTION

#### INTRODUCTION

Martin Marietta conducted an Orbital Transfer Vehicle Concept Definition and System Analyisis Study for NASA/MSFC under Contract No. NAS8-36108. A portion of that study, Task 5, addressed Space Station The results of the Task 5 Accommodations Concept Definition relative to the Orbital Transfer Vehicle. studies and investigations are reported in Volume IV of the Final Report.

The ROBSIM software system, running on a VAX 11/750 minicomputer and an Evans & Southerland Graphics workstation, is used to develop engineering data on robotic arm design as well as logistics timelines and operational procedures requirements definitions were generated to allow specific definiton of the OTV accommodations at Space using actual OTV hardware descriptions. Finite simulations of transport motion and remove & replace In the performance of Task 5, a large number of detailed functional flow analyses and resultant Appendix A to Volume IV of the Final Study Report is a compendium of those analyses and defintions. Station. ROBSIM (a robotic simulation developed under contract from NASA/LaRC) provided the basic tasks were run to establish baseline time data from which functional task times were developed and subsequently grouped into operations required to support processing, servicing, and maintenance. building blocks for determining task times for Space Station processing operations.

Space Based OTV, with further delineation for both cryogenic and storable OTVs, and for the Ground Based Within this Appendix A, functional flow analyses and requirements definitions are provided for the OTV operating in conjunction with Space Station.

#### INTRODUCTION

- **ORBITAL TRANSFER VEHICLE CONCEPT DEFINITION AND SYSTEM ANALYSIS** STUDY 0
- NASA I MSFC CONTRACT NAS8-36108 (PHASE A)
- TASK 5: SPACE STATION ACCOMMODATIONS CONCEPT DEFINITION

0

- **VOLUME IV OF FINAL STUDY REPORT**
- **APPENDIX A TO VOLUME IV**

0

- FUNCTIONAL FLOWS & REQUIREMENTS DEFINITIONS
- CRYOGENIC SPACE-BASED OTV
- STORABLE SPACE-BASED OTV
- GROUND-BASED OTV

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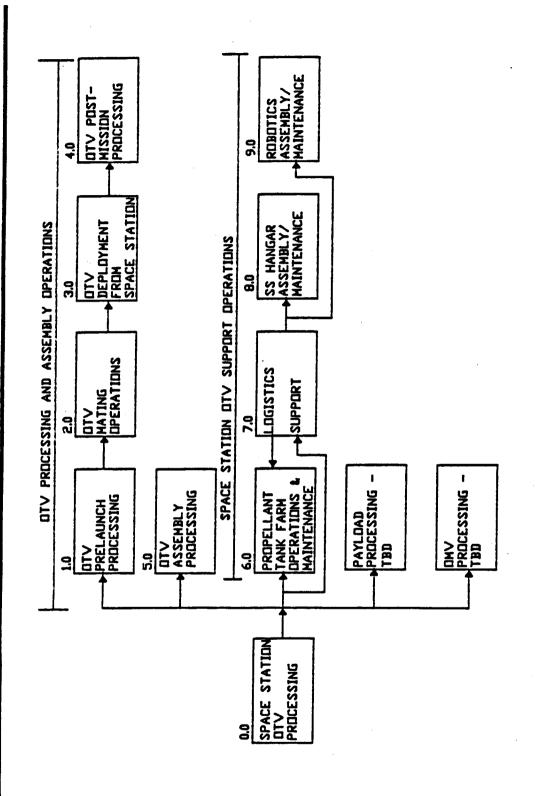
## **SPACE-BASED OTV**

# SPACE-BASED OTV FUNCTIONAL FLOW OVERVIEW

operations; and support operations. These categories were further subdivided into major functional areas to allow development of detailed OTV processing procedures and timelines. These procedures and timelines OTV processing at Space Station was divided into two major categories: OTV processing and assembly were used to derive the specific Space Station accommodations necessary to support OTV activities.

Our overall objective was to limit impact of OTV processing requirements on Space Station operations, systems, with the exception of the initial assembly of Space-Based OTV accommodations at Space Station, maximizes use of automated and robotic systems to perform all required OTV servicing and maintenance operations are considered to be strictly contingency back-up to failure of the automated and robotic tasks. Only potentially critical activities would require direct crew involvement or supervision. Our operational concept involvement of crew, and associated crew training and skill requirements. which will require manned involvement.

Each of the numbered major functional areas shown on the facing page chart is further defined in the following charts, first, for the Cryogenic SBOTV, and then for the Storable SBOTV. Behind each major functional area definition are the corresponding requirements definition sheets identifying tasks, facilities, tools, and timelines.



#### MARTIN MARIETTA

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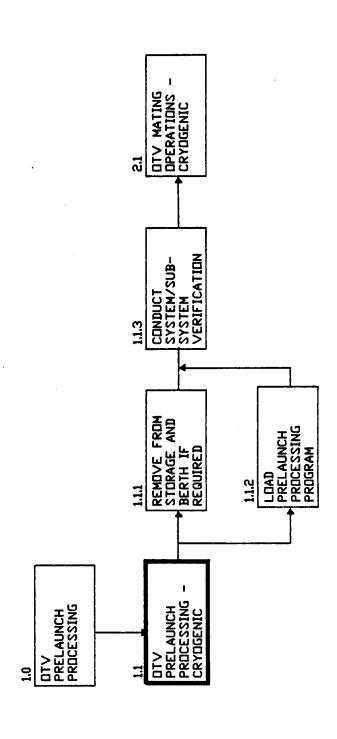
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# **CRYOGENIC SPACE-BASED OTV**

# CRYOGENIC SPACE-BASED OTV PRELAUNCH PROCESSING

This functional flow and corresponding requirements definitions addresses the operations necessary to prepare the Cryogenic SBOTV for payload mating prior to mission launch.

# CRYOGENIC SBOTV PRELAUNCH PROCESSING



SHEET 1 of 3

OTV PREIAUNCH PROCESSING - CRYOGENIC

			tate Wing a			hangar		RIGINAL PAGE IS E POOR QUALITY
	REMARKS		OTV fleet size would dictate OTV storage hangar requirements. The following sequence would apply if a storage hangar is required			May use MRMS or storage hangar berthing cradle		
MANHOURS	TOTAL	0:45- 1:30	0:45			0:45		
MAN	EVA							
CREW SUPPT	EVA							•
CREW	IVA	4:35-0:45-5:35 1:30	0:45			0:45		-
FUNC	TIME	4:35- 5:35	1:0	0:05	0:05	0:45	0:02	-
	TRNG	1	· -			2		
REOUIREMENTS	TOOLS	SS hangar, Control console, SS computer, ligting software, robotics, MRMS, power, tools/effectors signal, propellant		Control console, SS computer	Control console, SS computer	Control console, SS computer	Control console, SS. computer	
	FACILITIES	SS hangar, ligting power, signal, propellant						_
	TASK	OTV PreLaunch Processing - Cryogenic	Remove From Storage and Berth (if required)	Disconnect power and signal umbilical	Open storage hangar door	Translate OTV to processing hangar	Attach power and signal umbilicals	_
SPOIIFNCE	NUMBER	1.1	1.1.1	1.1.1.1	1.1.1.2	1.1.1.3	1.1.1.4	

SHEET 2 of 3

OTV PRELAUNCH PROCESSING - CRYOGENIC .

SECTIONS			REGITREMENTS		FUNC CREW SUPPT	CREW SI	PPT	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TIME   IVA   EVA	IVA	_	EVA   TOTAL	REMARKS
1.1.2	Load Prelaunch Processing		Control console, SS computer,		0:40 0:20	0:20		0:20	
1.1.2.1	riogiam  Verify program matchs OTV  configuration		Control console, SS computer		0:15  0:15	0:15		0:15	
1.1.2.2	Conduct program self-test		Control console, SS computer		0:20				
1.1.2.3	  Verify program self-test		Control console, SS computer		0:05 0:05	0:05		0:05	

SHEET 3 of 3

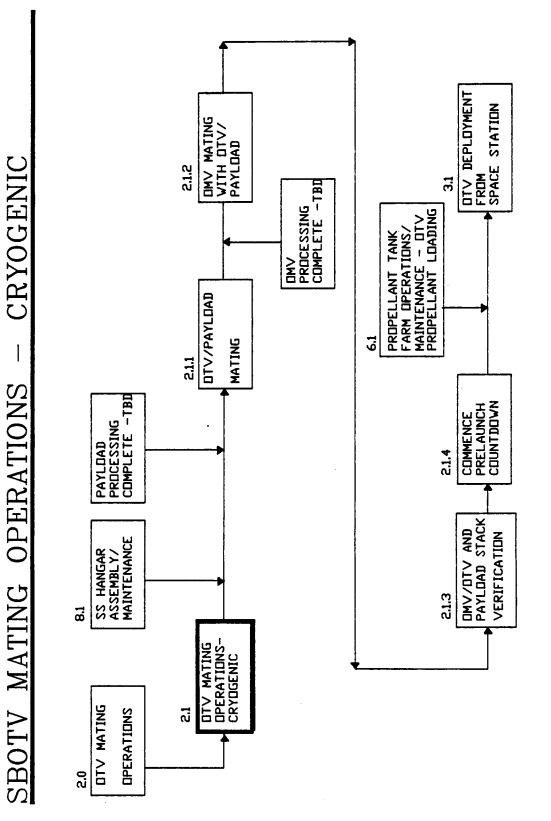
OTV PRELAUNCH PROCESSING - CRYOGENIC

REMARKS							Fuel cells checked following RCS propellant transfer		
MANHOURS A TOTAL	0:25	0:10					Fuel RCS		0:15
CREW SUPPT	25	- <u>-</u> -							15 -
1 1 1	3:55 0:25	0:10  0:10	1:00	0:30	0:30	0:30	0:30	0:30	0:15 0:15
FUNC WG TIME	-ë1 	- <u>ö</u> -	<u> </u>	- <del>-</del> -	- <del>-</del> -	ö 	ö 	ö 	- <del>-</del> -
TRNG		<del></del> -	<del>-</del> -	<del></del> -	<del>-</del>	<u></u>			
REQUIREMENTS TOOLS	Control console, SS computer, software	Control console, SS computer	Control console, SS computer	  Control console, SS computer	Control console, SS computer	Control console, SS computer	Control console, SS computer	Control console, SS computer	
FACILITIES									
TASK	Conduct System/Subsystem Verification - Self Test	Load program and conduct auto test of the following subsystems	Avionics	GN&C	Data management	Communications and tracking (less RF antenna systems)	Power (less fuel cells)	  Payload interface system	  Verify self test
SEQUENCE NUMBER	1.1.3	1.1.3.1	1.1.3.2	1.1.3.3	1.1.3.4	1.1.3.5	1.1.3.6	1.1.3.7	1.1.3.8

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# CRYOGENIC SPACE-BASED OTV MATING OPERATIONS

payload and OMV mating and the attendant operations required to checkout and verify the OMV/OTV/Payload This functional flow and set of requirements definitions addresses the operations associated with stack.



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SHEET 1 of 12

	REMARKS				See 7.0 Logistics Support	See 8.0 SS Hangar Assembly/ Maintenance	Assumed to be in hangar			Correct anomalies
MANHOURS	TOTAL	10:25		1:45	1	1	0:15	0:15	0:15	1:00
HANH	EVA									
SUPPT	EVA					. — — -		. – – –		
CREW SUPPT	IVA	10:25		1:45	!	1	0:15	0:15	0:15	1:00
FUNC	TIME	15:30		1:45		!	0:15	0:15	0:15	1:00
	TRNC				1	!	8	7	7	~
REOUIREMENTS		SS hangar, Control console, SS computer ligting, RMS, robotics, CCTV software power.	4 0				Control console, SS computer, RMS, CCTV	Control console, SS computer, RMS, CCTV	Control console, SS computer,   CCTV	Control console, SS computer,
	FACILITIES	SS hangar, ligting, power,	signai, propellant umbilicals	<b>-</b>						
	TASK	OTV Mating Operations - Gryogenic		OTV/Payload Mating	Logistic support available to support mating operations	Verify hangar contamination level	Translate payload to OTV processing area	Secure payload to mating cradle	Verify OTV/payload alignment	Mate OTV/payload - verify proper electrical/mechanical interfaces
SEOHBNCE	NUMBER	2.1		2.1.1			2.1.1.1	2.1.1.2	2.1.1.3	2.1.1.4

SHEET 2 of 12

	REMARKS					0:15   Correct anomalles	
MANHOURS	TOTAL	1:15	0:30	0:15	0:15	0:15	
1	EVA						
CREW SUPPT	EVA						
CREW	IVA	1:15	0:30	0:15 0:15	0:15   0:15	0:15 0:15	
FUNC	TRNG   TIME	1:20	0:30	0:15	0:15	0:15	0:02
	TRNG		7	7	~	- <del></del>	
REOUIREMENTS	ES TOOLS		Control console, SS computer, RMS, CCIV	Control console, SS computer, RMS, CCTV	Control console, SS computer,   RMS, GCTV	Control console, SS computer,	Control console, SS computer,
	FACILITIES						
	TASK	OMV Mating with OTV/Payload	Translate OMV to OTV processing area	Secure OMV to mating cradle	Verify OMV/OIV alignment	Mate OMV/OTV - verify proper  mechanical-interfaces	Connect power, signal, umbilicals to OMV
SPOHENCE	NUMBER	2.1.2	2.1.2.1	2.1.2.2	2.1.2.3	2.1.2.4	2.1.2.5

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SHEET 3 of 12

STATE OF THE STATE			REQUIREMENTS		FUNC	CREW SUPPT		MANHOURS	
NUMBER	TASK	PACILITIES	TOOLS	TRNC	TRNG TIME	IVA LEVA	VA LEVA	A TOTAL	REMARKS
2.1.3	OMV/OTV/Payload Stack Verification	· · · ·		1	0:30   0:30	0:30		0:30	
2.1.3.1	Verify mechanical/electrical connections		Control console, SS computer, CCTV	<b>#</b>	0:20 0:20	0:50		0:50	
2.1.3.2	Verify stack is ready to commence prelaunch countdown		Control console, SS computer		0:10  0:10	0::0		0:10	

OTV MATING OPERATIONS-CRYOGENIC

SHERT 4 of 12

OURS 1	TOTAL REMARKS	6:55	4:05   See 6.0 Propellant Tank		0:05	4:00   Monitor for leaks
MANHOURS	EVA					
SUPPT	EVA					
FUNC   CREW SUPPT	IVA	6:55	4:25 4:05		10:05	4:00
FUNC	TIME	11:55 6:55	4:25	0:20	0:05 0:05	4:00 4:00
	TRNC	 	!			~~~
REQUIREMENTS	FACILITIES TOOLS		Control console, SS computer, leak detection equipment	Control console, SS computer	Control console, SS computer	Control console, SS computer,   leak detection equipment
•	TASK FACI	Commence Prelaunch Countdown	Propellant Transfer	Attach propellant umbilicals	Verify detection equipment operational	Complete propellant transfer
SEQUENCE	NUMBER	2.1.4	2.1.4.1	2.1.4.1.1	2.1.4.1.2	2.1.4.1.3

SHEET 5 of 12

	REMARKS				Correct anomalies - See 4.0 for maintenance activities
HOURS	TOTAL	0:30	0:15	0:15	2 4 8
MAN	EVA				
FUNC   CREW SUPPT   MANHOURS	EVA		<b></b> _		
CREW	ΨΛΙ	1:00 0:30	0:15	0:15 0:15	
FUNC	TIME	1:00	   0:15  0:15	0:15	0:30
	TRNG	 !	-		- 
REQUIREMENTS	TIES TOOLS		  Control console, SS computer	Control console, SS computer	Control console, SS computer
	FACILITIES				
	TASK	Conduct Avionics Module Testings	Verify OTV configuration	Select, verify and load diagnostic checkout program	Conduct diagnostic testing of avionics systems (less RF antennas)
SEQUENCE	NUMBER	2.1.4.2	2.1.4.2.1	2.1.4.2.2	2.1.4.2.3

#### SHEET 6 of 12

	REMAKKS				
CREW SUPPT   MANIFOURS	IVA EVA EVA TOTAL	0:05			0:02
T	EVA			<u>-</u>	
EW SUPP	A EVA	:SI - – -		<del>.</del> –	05 -
FUNC CR	Œ IV	0:35   0:05	0:15	0:15	0:05 0:05
FUN	TRNG TIME	- öl - <del></del> - 	ö 		 
REQUIREMENTS	FACILITIES   TOOLS   TI		Control console, SS computer	Control console, SS computer	
	TASK	Conduct Power Checks	Verify fuel cell propellant	  Verify fuel cell operation	Verify self-test
SECUENCE	NUMBER	2.1.4.3	2.1.4.3.1	2.1.4.3.2	2.1.4.3.3

#### SHEET 7 of 12

SEQUENCE			REQUIREMENTS		FUNC	FUNC - CREW SUPPT	UPPT	MANHOURS	JRS 1	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TRNG TIME	IVA	EVA	EVA T	TOTAL	REMARKS
2.1.4.4	Load Mission Program			-	1:30	0:30		!	0:30	
2.1.4.4.1	Verify mission program prior		Control console, SS computer		0:20 0:20	0:20			0:20	
2.1.4.4.2	Load program, conduct		Control console, SS computer		1:00					
2.1.4.4.3	Verify program test				0:10  0:10	0:10			0:10   Correct anomalies	anomalies

SHEET 8 of 12

SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	UPPT	MANHOURS	
NUMBER	TASK	PACILITIES	1001.8	TRNC	TRNG   TIME	IVA	EVA E	EVA TOTAL	AL REMARKS
2.1.4.5	Main Engine Check			!	1:30	0:25		<u></u>	0:25
2.1.4.5.1	Load self-test program				0:10 0:10	0:10			0:10
2.1.4.5.2	Engine valve operation check		Control console, SS computer	7	0:15				
2.1.4.5.3	  Ignition system check		Control console, SS computer	~~~	0:15				
2.1.4.5.4	Instrumentation checkout		Control console, SS computer	~	0:20				
2.1.4.5.5	Solenoid checkout		Control console, SS computer		0:15				
2.1.4.5.6	Verify self-test			~	0:15	0:15 0:15		ö 	0:15   Correct anomalies - See 4.0   for maintenance activites

OTV MATING OPERATIONS-CRYOGENIC

SHEET 9 of 12

			PROHITOGRAPHS		FUNC	PILING CREW SUPPT   MANIFOURS	T MA	HOURS	
SECHENCE			RECOLUENTALO			A11.4	A COLD	TOTAL	REMARKS
NIMBED	TASK	FACILITIES	TOOLS	TRNG	Ž	TRNG TIME LIVA LEVA LEVA LOLOR	EVA	70101	
Moringen				_		_		-	
	In the Canton Chook			<u> </u>	0:20   0:20	0:20		     	
7.1.4.0	Propertant System onces			_			_	_	. `
2,1,4,6,1	  Verify leak check		Control console, SS computer	-	0:05 0:05	0:05		0:05	0:05   Correct anomalies
	equipment operational		leak detection equipment						
			Contract computer GC committee	~	0:15 0:15	0:15	_	0:15	0:15  Correct anomalies - See 4.0
2.1.4.6.2	Verify propellant subsystems		Control consore, 33 compare:	· —		_			for maintenance activities
	loperating within itera			_			_	_	
	-	-							

SHEET 10 of 12

OTV MATING OPERATIONS-CRYOGENIC

SHRET 11 of 12

REMARKS					0:15   Correct anomalies - See   payload maintenance   activities - TBD
MANIJOURS A TOTAL	0:15				0:15
CREW SUPPT IVA EVA					
1 1 4	0:15				0:15 0:15   
TIME	1:05	0:15	0:20	0:15	0:15
TRING	<u> </u>	~	~	~	~
REQUIREMENTS 51 TOOLS		Control console, SS computer, CCTV	Control console, SS computer	  Control console, SS computer	
FACILITIES					
TASK	Verify Health and Status of Payload	Reverify electrical/ mechanical OTV payload interface	Verify proper power levels and telemetry data	  Verify payload ACS operation  /propellant load	Verify self-test
Sequence Number	2.1.4.8	2.1.4.8.1	2.1.4.8.2	2.1.4.8.3	2.1.4.8.4

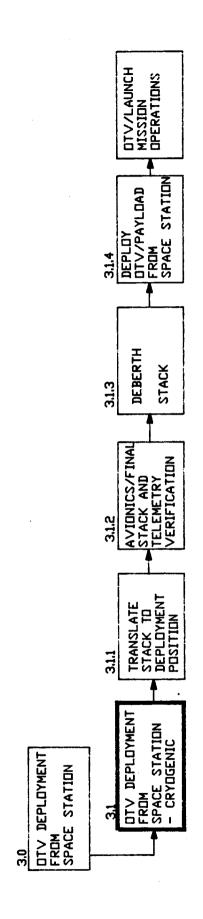
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SHEET 12 of 12

SECUENCE			REQUIREMENTS		FUNC	CREW SUPPT		MANHOURS	
NOMBER	TASK	FACILITIES	TOOLS	TRMC	TIME	IVA   EVA	A EVA	TOTAL	REMARKS
2.1.4.9	Verify Health and Status of OMV				1:00	0:15		0:15	
2.1.4.9.1	Reverify mechanical OMV/OIV Interface		Control console, SS computer	~~~	0:10				
2.1.4.9.2	Verify proper power levels and telemetry data	·	Control console, SS computer		0:20				
2.1.4.9.3	  Verify propellant load		Control console, SS computer	~ 	0:15				
2.1.4.9.4	Verlfy self-test			~	0:15	0:15  0:15		0:15	0:15   Correct anomalies - See OMV
									מינונייייי מינוניייייייייייייייייייייייי

## CRYOGENIC SPACE-BASED OTV DEPLOYMENT

A functional flow and requirements definition set relative to deployment of the Cryogenic SBOTV, mated with a payload and the OMV, from Space Station is provided.



OTV DEPLOYMENT FROM SPACE STATION - CRYOGENIC

SHEET 1 of 4

SEQUENCE NUMBER	TASK	FACTLITIES	REQUIREMENTS TOOLS	TRNG	FUNC	CREW SUPPT	MANHOURS	REMARKS
3.1	OTV Deployment From Space Station - Cryogenic	SS hangar, Control collighting, CCTV, RMS power	98 e		2:40			
3.1.1	Translate Stack to	propellant			1:15	0:30	 0:30	
3.1.1.1	Deployment Position Verify mating/checkout		Control console, SS computer	~~~	0:20		 	
3.1.1.2	Release propellant umbilicals		Control console, SS computer CCTV		0:20		 	
3.1.1.3	Open hangar doors		Control console, SS computer CCTV		0:05		 	
3.1.1.4	Translate stack to hangar porch		Control console, SS computer CCTV	~	0:30 0:30	0:30	 0:30	

SHEET 2 of 4

OTV DEPLOYMENT FROM SPACE STATION - CRYOGENIC

SHEET 3 of 4

OTV DEPLOYMENT FROM SPACE STATION - CRYOGENIC

SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	-	MANITOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC TIME	П	IVA   EVA		TOTAL	REMARKS
3.1.3	Release Deberth Stack				0:35	0:05		0.05	
3.1.3.1	Release latches on OMV		Control console, SS computer, CCTV		0:05			0:02	
3.1.3.2	Collapse OMV mating cradle		Control console, SS computer, CCTV		0:05			0:02	
3.1.3.3	Release latches on payload		Control console, SS computer, CCTV		0:05			0:02	
3.1.3.4	Collapse payload mating cradle		Control console, SS computer, CCTV		0:02			0:02	
3,1,3,5	Attach space crane; release latches on OTV and collapse berthing cradle		Control console, SS computer, CCTV	8	0:02			0:05	
3.1.3.6	Release power and signal umbilicals		Control console, SS computer, CCTV		0:05			0:02	
3.1.3.7	Verify sequence complete			~	0:05	10:05		0:02	

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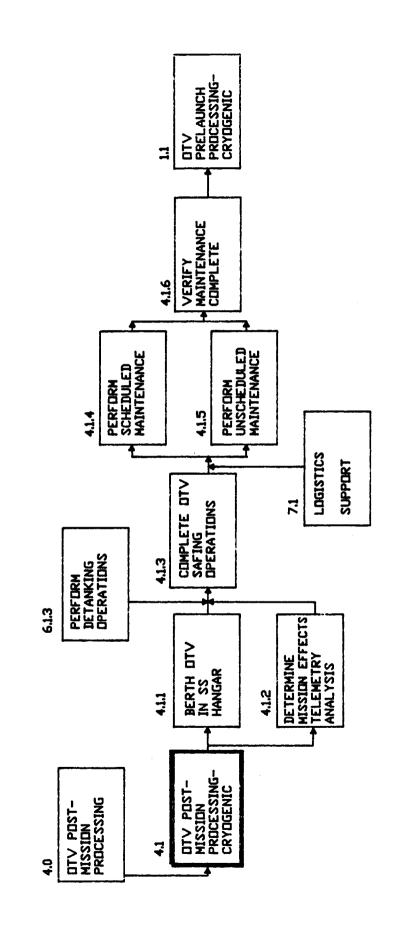
OTV DEPLOYMENT FROM SPACE STATION - CRYOGENIC

SHEET 4 of 4

SEQUENCE			REQUIREMENTS		FUNC	CREWS	CREW SUPPT	MANIFOURS	OURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	ΥΛΊ	EVA	EVA	TOTAL	REMARKS
3.1.4	Deploy OMV/OTV/Payload from Space Station				0:30 0:30	0:30			0:30	
3.1.4.1	Translate OTV and space crane to deployment position		Control console, SS computer, CCTV	8	0:30  0:30	0:30			0:30	
3.1.4.2	Deploy stack		Control console, SS computer,	~~~			^		- <del></del> -	
3.1.4.3	Transfer conrol of stack to Space Station			~ ~ ~		 			<del></del>	

## CRYOGENIC SPACE-BASED OTV POSTMISSION PROCESSING

The operations associated with retrieval of the Cryogenic SBOTV and OMV, with or without a return payload, and the safing, demating, detanking, and maintenance operations necessary after the return from a mission are provided in the following charts.



CRYOGENIC

SBOTV POSTMISSION PROCESSING

## Assumptions:

- All major components will be removed as a unit i.e., Fuel Tanks, Regulators, Avionics Modules, Engine(s).
- Only items that cannot be replaced on orbit will be located within the core structure.
- each major task. Tool Kits, special tools and robotic effectors will be provided for
- GPS antenna system is not permanently bonded to LO2 propellant tanks.
- RF cabling can be disconnected from the octagonal avionics assembly as a unit, to support GPS antenna system replacement.
- Octagonal avionics assembly will not be removed from the core structure.

•

- Core structure and octagonal avionics assembly will be delivered to the Space Station as a single assembled unit.
- Removal of the main propulation engine(s) will not require removal of the aerobrake.
- Robotics will be capable of reaching all connect/disconnect points on the vehicle.

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> Robotics will be used to the maximum extent possible to preclude EVA operations except in contingencies. 9

## Common Actions Associated With All Functions

- Verify OTV berthing and latching prior to any activities.
- Verify OTV propellant levels and safing.
- Verify operations of remote manipulator systems and robotics.
- Verify current maintenance procedures and robotic programs are available and loaded.
- Verify that tools/effectors are available and serviceable.
- Verify that all required test equipment is on hand and operational. Computer programs are available. ٠.
- SS hangar will be clear of all packaging debris after every maintenance activity Disposal bags will be required during all maintenance activities. 7

OTV POSTMISSION PROCESSING - CRYOCENIC

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	TASK OTV Postmission Processing Cryogenic	SS hanger, lighting, power signal, propellant umbilicals berthing	S hanger, Control console, SS computer, lighting, CCTV, robotics, tools/ power effectors, propellant umbilicals berthing cradle,	uter, -	ANII	INTERPORT	SOUTH CONTRACTOR OF THE CONTRA	EVA TOTAL		REMARKS	
•	Berth OTV in Space Station Hangar	X X			2:10	2:00			2:00		
	Open hangar doors		  Control console, SS computer	uter   1	0:05						
	Translate OTV berthing structure onto hangar porch		Control console, SS computer	uter   1	0:15						
	Position MRMS for OTV retrieval		Control console, SS computer	uter   2	0:15	0:15		_ë_	0:15		
	Secure MRMS to OTV grappeling fixtures		Control console, SS comp	computer, 2	0:50	0:20		<u> </u>	0:20		
	Translate OTV to berthing cradle		Control console, SS comp	computer, 2	0:30	0:30		_ <u>=</u>	0:30		
	Position OTV in berthing cradle		Control console, SS computer,	uter,   2	0:02	0:05	<b>-</b> -	<u> </u>	0:05		
	Release MRMS grapples -		Control console, SS computer	uter   2	0:20	0:20		<u> </u>	0:20		
	Demate OMV for OTV		Control console, SS computer	uter   2	0:05	0:05		<u>- ë</u>	0:02		
	Translate OTV into hangar - secure hangar doors		Control console, SS computer	uter   2	0:30	0:25	<b></b>	<u> </u>	0.25		

OTV POSTMISSION PROCESSING - CRYOGENIC

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	3KS								
	I REMARKS				As required		  See 6.1.3  OTV detanking		
MANHOURS	TOTAL	3:15-	10:15	0:15	0:45	0:15	  2:15 	<del></del> -	  0:15 
<u> </u>	E								
CREW SUPPT	EVA								
	IVA	5:45- 3:15- 6:30  4:00	5  0:15	0:15  0:15 	0:45 0:45	5 (0:15 1	 5  2:15 		0:15  0:15
FUNC	TIME	5:4	0:15		0:4	0:15	2:15	2:30	0:13
	TRNC				7	~	- <del></del> -		
REQUIREMENTS	TOOLS	Control console, SS computer, CCTV, leak detection equipment	Control console, SS computer,	Control console, SS computer, leak detection equipment	Control console, SS computer	Control console, SS computer	Control console, SS computer, CCTV	Control console, SS computer	Control console, SS computer
	FACILITIES								
	TASK	Determine Mission Effects - Telemetry Analysis	Conduct visual inspection of OTV - hazardous conditions	Conduct leak check	Demate/secure payload	Load diagnostic program and verify as-flown condition	Commence detanking of residual propellants	Run diagnostic program on as-flown configuration	Prepare maintenance plan
SEQUENCE	MIMBER	4.1.2	4.1.2.1	4.1.2.2	4.1.2.3	4.1.2.4	4.1.2.5	4.1.2.6	4.1.2.7

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SEQUENCE			REOUIREMENTS		PUNC	CREW SUPPT	UPPT	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	IVA	7	EVA   TOTAL	REMARKS
4.1.3	Complete OTV Safing Operations			1	0:40	0:35		0:35	
4.1.3.1	Verify propellant valves		Control console, SS computer	7	1	1		 <del></del> -	
4.1.3.2	Conduct leak check		Control console, SS computer, leak check equipment	-	0:10	0:10		0:10	
4.1.3.3	Verify tank pressure stabjilzed		Control console, SS computer pressure gauges	7	0:10	0:10		0:10	
4.1.3.4	Disconnect propellant umbilical		Control console, SS computer	7	0:10			. <del></del>	
4.1.3.5	Verify critical electrical and avionics components safed		Control console, SS computer	-	0:15	0:15   0:15		0:15	

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4.1.4.1.2 Translate robotics to propellant tank work area 4.1.4.1.2 Translate robotics to propellant tank work area 4.1.4.1.2 Translate robotics to propellant tank work area 4.1.4.1.3 Visually inspect propellant tank and valve system 4.1.4.1.4 Conduct diagnostic testing		REQUIREMENTS			FUNC	CREW SUPPT	PFI	MANIBOURS	
Perform Scheduled   Maintenance	FACILITIES	TOOLS		TRNC	TIME	IVA  E	EVA EV	EVA   TOTAL	L   REMARKS
Propellant Tank Scheduled Maintenance Translate robotics to tool area and secure tools/ effectors  Translate robotics to propellant tank work area Visually inspect propellant tank and valve system Conduct diagnostic testing				,	1				
Translate robotics to tool area and secure tools/ effectors Translate robotics to propellant tank work area Visually inspect propellant tank and valve system Conduct diagnostic testing	SS hangar SS 11ghting, tes power, CCT signal,	SS computer, control console, test equipment, robotics, CCIV, tools/effectors	ol console,   botics, ors	1	2:15	1:55		1:55	Computer interfaces with   lonboard diagnostic   equipment/systems   o includes an external visual   departion (CCTV)
	propellant  umbilicals	Control console, SS computer,	S computer,		0:05				o PU and TVS system
		Control console, SS computer	S computer		0:05				
<del></del>	Cor	Control console, CCTV, robotics	crv,		1:40	1:40		1:40	
	<u>8</u>	Control console, SS computer	S computer		0:15	0:15		0:15	<pre>5  Non-destructive test   equipment</pre>
4.1.4.1.5 Translate robotics to tool area store tools/effectors	CCTV	Control console, SS computer, CCTV	S computer,		0:05				
4.1.4.1.6 Translate robotics to	<u>8</u>	Control console, SS computer	S computer		0:05				

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SEQUENCE			REQUIREMENTS			FUNC CREW SUPPT	CREW	TAM	MANHOURS	OURS	
NUMBER	TASK	FACILITIES	TOOLS		TRNG   TIME	TIME	IVA		EVA	TOTAL	REMARKS
4.1.4.2	Avionics Scheduled Maint.										·
4.1.4.2.1	Module Test	SS Hangar, 11ghting,	SS Hangar, Control console, SS computer, lighting, test equipment	computer,	. سننيد	2:05	0:30			0:30	
		power, signal, propellant umbilicals						<del> ·</del>		<del></del>	
4.1.4.2.1.1	Verify signal and power umbilicals connected		Control console, SS computer	omputer		0:10					
4.1.4.2.1.2	Verify required test software is loaded into SS computer		SS computer, control console	console	~~~	0:15	0:15			0:15	
4.1.4.2.1.3	Conduct test		SS computer, control console	console		1:25				_ = = -	Replace defective modules.
4.1.4.2.1.4	  Verify self-test complete		SS computer, control console	console	7	0:15  0:15	0:15			0:15	

OTV POSTMISSION PROCESSING - CRYOGENIC

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	TASK	FACILITIES	REQUIREMENTS TOOLS	TRNC	FUNC	IVA EVA	111	EVA TOTAL	REMARKS
Scheduled Module Replacement   SS   11   12   12   13   14   15   15   15   15   15   15   15	_ <u>g                                    </u>	SS hangar, lighting, power, signal, propellant	Control console, SS computer, CCTV, robotics, test equipment, tools/effectors, LRU's		1:50	00		1:00	
Translate robotics to tool area and secure tools/ . effectors			Control console, SS computer, robotics, CCIV		0:05			. <b></b>	
Translate robotics to spare parts storage area - secure replacement module and store			Control console, SS computer, robotics, CCTV	. <del>-</del>	0:05				· 
Translate robotics to work site			Control console, SS computer	<u>-</u>	0:05				
Remove avionics module and store			Control console, SS computer, robotics, CCTV, tools/ effectors	~	0:15	0:15		0:15	
Visually inspect module mounting interface for defects			Control console, SS computer, CCTV, robotics,	~	0:02	0:05		0:05	·
Install replacement module			Control console, SS computer, CCIV, robotics, tools/ effectors	8	0:15	0:15		0:15	
Conduct module test/			Control console, SS computer	<del></del> -	10:30	0:05		0:05	
Translate robotics to parts storage area-package module for shipment			Control console, SS computer, robotics, CCTV		0:20	0:20		0:20	0 Return to earth
Translate robotics to tool storage and secure tools			Control console, SS computer, robotics, CCTV	<u></u>	0:05		· <b></b> -	. — — —	
Translate robotics to storage and secure			Control console, SS computer		0:03				

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REMARKS					
HANHOURS    A     TOTAL	0:10		0:02		0:02
CREW SUPPT	0:10		0:03		0:02
FUNC	0:45 0:10	0:05	0:05	0:30	10:05
TRNC				7	
REQUIREMENTS TOOLS	SS Hangar, Control console, SS computer, lighting, software signal, power, propellant umbilicals	Control console, SS computer	Control console, SS computer, software	Control console, SS computer, software	Control console, SS computer
FACILITIES	SS Hangar, lighting, signal, power, propellant				
TASK	ACS Update	Verify power and signal umbilicals are connected	Verify ACS update loaded	Update ACS	Verify update complete
SEQUENCE	£.	4.1.4.2.3.1	4.1.4.2.3.2	4.1.4.2.3.3	4.1.4.2.3.4

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SEQUENCE			REQUIREMENTS		FUNC	FUNC CREW SUPPT	UPPT	MANHOURS	URS 1	
NUMBER	TASK	FACILITIES	T001.S	TRNG	TRNG TIME	IVA	EVA	EVA	TOTAL	REMARKS
4.1.4.2.4	Avionic - Mission Peculiar									
4.1.4.2.4.1	Module Replacement	SS hangar, 11ghting,	SS hangar, Control console, SS computer, 11+2 11ghting,  robotics, CCTV, tools/effector		1:50	1:00			1:00	
	See 4.1.4.2.2	power, signal, propellant umbilicals	checkout equipment, software							
4.1.4.2.4.2	Reconfiguration	SS hangar lighting power.	Control console, SS computer, robotics, CCTV, tools/effectors. checkout equipment.	1+5	11:50	1:00			1:00	
		signal, propellant umbilicals	software							

OTV POSTMISSION PROCESSING - CRYOGENIC

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SUANDE	CAMPLE					t anomalies	
MANHOURS	70101		0:35		0:02	0:30   Correct anomalies	
WAN	T (	_ : 					
CREW SUPPT   MA	2	· 					
1 1	<b>-</b>  -		0:32		0:05 0:05	0:30 0:30	
FUNC			0:50	0:10	0:0	ж 	0:02
29	TRUM			~			~
REQUIREMENTS			SS hangar, Control console, SS computer, 11ghting,   CCTV, test equipment, RMS power,   signal,   propellant   propellant	Control console, SS computer	Control console, SS computer	Control console, SS computer	Control console, SS computer
24/41 14/14	FACILITIES		SS hangar, lighting, power, signal, propellant umbilicals				
2046	Yeyr	RCS Scheduled Maintenance	Leak Check	Condition propellant	Connect umbilical and verify connection	Conduct leak check and verify	Disconnect propellant
SEQUENCE	NUMBER	4.1.4.3	4.1.4.3.1	4.1.4.3.1.1	4.1.4.3.1.2	4.1.4.3.1.3	4.1.4.3.1.4

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SEQUENCE			REQUIREN		FUNC	FUNC   CREW SUPPT	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRMC	TRNG   TIME	IVA EVA	EVA TOTAL	REMARKS
4.1.4.3.2	Transducer Check	SS hanger, lighting, power, signal, propellant umbilicals	SS hanger, Control console, SS computer, lighting, software, CCTV power, signal, propellant umbilicals	1	0:55	0:20	 0:20	
4.1.4.3.2.1	Verify power, signal and propellant umbilicals		Control console, SS computer CCTV		0:05		 	
4.1.4.3.2.2	Load transducer check software	· 	Control console, SS computer, software		0:15 0:15	0:15	 0:15	
4.1.4.3.2.3	Conduct transducer check		SS computer, software		0:30		 	
4.1.4.3.2.4	Verify check complete		SS computer, control console	7	0:05 0:05	0:05	 0:05	

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SEQUENCE			REQUIREMENTS		FUNC		MAN		
	TASK	FACILITIES	TOOLS	IKK	TIME	IVA	EVA	TOTAL	
4.1.4.3.3	RCS - Resupply	SS hanger, lighting,	SS hanger, Control Console, SS computer, 11ghting, RCS software		1:50	1:35		1:35	
		power, signal, propellant umbilicals							-
4.1.4.3.3.1	Condition propellant   umbilical		Control console, SS computer	~~~	0:10			<b></b> 445 - 4	
4.1.4.3.3.2	Connect propellant umbilical and verify connection		Control console, SS computer, RMS		0:05	0:05		0:05	
4.1.4.3.3.3	Transfer RCS propellant		Control console, SS computer, lesk detection equipment	~	1:15	1:15		1:15  Monitor for leaks	
4.1.4.3.3.4	Blow back propellant  umbilical when transfer  complete		Control console, SS computer	~	0:15 0:15	0:15		0:15	
4.1.4.3.3.5	Disconnect propellant		Control console, SS computer, RMS	~	0:05			·	
	_	_		-		_	-	_	

	REMARKS										Return to earth		
WANTIGUE C	TOTAL		1:30				0:30	0:02	0:30	0:02	0:20		,
-	EV												
100	-i		1:30		. <b></b> .		0:30	0:05	0:30	0:05	0:20		
Γ	TIME IVA		2:20 1:	0:02	0:05	0:05	0:30	0:02	0:30	0:30  0:	0:20	0:02	
100	TRNG TI					- <del>-</del>	~	~	~	 -		- <del>-</del>	
PHANTA CARREST CO.	REQUIREMENTS TOOLS		hanger, Control console, SS computer, hting, robotics, CCTV, tools/er, effectors nal, pellant	Control console, SS computer, robotics, CCTV	Control console, SS computer, robotics, CCTV	Control console, SS computer	Control console, SS computer, robotics, CCTV, tools/ effectors	Control console, SS computer, CCTV	Control console, SS computer,  robotics, CCIV, tools/  effectors	SS computer, software	Control console, SS computer, robotics, CCIV	Control console, SS computer, robotics, CCTV	•
	FACILITIES		SS hanger, lighting, power, signal, propellant										
	TASK []	tenance	Scheduled Transducer Replacement	Translate robotics to tool storage area and secure tools/effectors	Translate robotics to parts storage area select LRU and store	Translate robotics to work site	Remove transducer and store	Conduct visual inspection	Install and secure replacement transducer	Conduct transducer check and verify	Translate robotics to parts storage area - package for shipment	Translate robotics to tools storage area, secure tools	
	SEQUENCE NUMBER	4.1.4.3.4	4.1.4.3.4.1	4.1.4.3.4.1.1	4.1.4.3.4.1.2	4.1.4.3.4.1.3	4.1.4.3.4.1.4	4.1.4.3.4.1.5	4.1.4.3.4.1.6	4.1.4.3.4.1.7	4.1.4.3.4.1.8	4.1.4.3.4.1.9	

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MARTIN MARIETTA REMARKS 0:20 |Return to earth 0:15 0:20 0:30 0:15 0:30 0:10 MANHOURS FVA TOTAL 2:20 CREW SUPPT IVA EVA 0:10 0:50 0:30 0:15 0:30 0:15 0:50 2:20 0:15 0:05 0:15 0:30 0:20 0:15 0:20 0:30 0:05 0:05 2:55 0:05 0:05 0:05 FUNC TRNG -7 ~ ~ ~ 7 Control console, SS computer, Control console, SS computer, Control console, SS computer, robotics, CCTV Control console, SS computer, CCTV Control console, SS computer Control console, SS computer, computer, Control console, SS computer, robotics, CCIV, tool/ Control console, SS computer, Control console, SS computer, robotics, CCTV SS hanger, Control console, SS computer, lighting, LRU's, robotics, CCTV, tools/ Control console, SS computer Control console, SS computer Control console, SS computer leak detection equipment A-51 Control console, SS REQUIREMENTS robotics, CCIV robotics, CCTV robotics, CCTV robotics, CCTV robotics, CCTV effectors effectors propellant FACILITIES umbilicals signal, power, parts storage area - secure spare thrusters and store Translate robotics to parts Connect thruster propellant lines and electrical Translate robotics to spare Translate robotics to tool Translate robotics to tool Remove and store thruster area - package thrusters for shipment storage area and secure tools/effectors storage area and secure Translate robotics to electrical interfaces Translate robotics to Blow back propellant lines and disconnect propellant lines and Install new thruster Disconnect thruster area, secure tools Connect propellant umbilical Scheduled Thruster Replacement Conduct leak check TASK Interfaces work site 4.1.4.3.4.2.10 4.1.4.3.4.2.13 4.1.4.3.4.2.11 4.1.4.3.4.2.12 4.1.4.3.4.2.9 4.1.4.3.4.2.5 4.1.4.3.4.2.6 4.1.4.3.4.2.4 4.1.4.3.4.2.8 4.1.4.3.4.2.1 4.1.4.3.4.2.2 4.1.4.3.4.2.3 4.1.4.3.4.2.7 4.1.4.3.4.2 SEQUENCE NUMBER

0:30

0:30 |0:30

0:10

Control console, SS computer

|Verify self-test complete

Disconnect umbilicals

4.1.4.4.1.13

4.1.4.4.1.14

Solenoid checkout

4.1.4.4.1.12

0:20

computer, software

SS

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Flight data analysis REMARKS 0:10 EVA TOTAL 0:40 FUNC CREW SUPPT | 0:10 0:40 1 0:30 0:10 0:35 0:10 0:10 0:20 0:30 4:15 0:10 0:10 TRNG Control console; SS computer, | SS hanger, | Control console, SS computer, | 11ghting, | robotics, CCTV | Ground | SS computer, ground computer Control console, SS computer SS computer, engine software SS computer, engine software computer, software, CCTV SS computer, software, CCTV SS computer, CCTV robotics SS computer, software computer, software computer, software SS computer, power, aignal, propellant PACILITIES Engine valve operation check Scheduled Engine Maintenance Instrumentation checkout Post Flight Maintenance Analysis of filght data Load self-test program Lock up pressure decay Nozzle extension check Turbopump torque check Gimbal actuator check Ignition system check Connect umbilicals Nozzle inspection TASK 4.1.4.4.1.11 4.1.4.4.1.10 4.1.4.4.1.9 4.1.4.4.1.2 4.1.4.4.1.3 4.1.4.4.1.4 4.1.4.4.1.5 4.1.4.4.1.6 4.1.4.4.1.7 4.1.4.4.1.8 4.1.4.4.1.1 4.1.4.4.1 SEQUENCE NUMBER 4.1.4.4

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SFOILENCE			REQUIREMENTS		FUNC	CREW S	SUPPT	3		
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TIME		EVA	EVA	TOTAL	REMARKS
4.1.4.4.2	Engine - Periodic Maint	SS hanger, lighting, power, signal, propellant	SS hanger, Control console, SS computer lighting, boroscope, robotics, LRU, power, tools/effectors signal, propellant umbilicals		2:00	1:30			1:30	
4.1.4.4.2.1	Translate robotics to tool storage area - secure tools/effectors		Control console, SS computer, RMS, robotics, CCTV		0:05					
4.1.4.4.2.2	Translate robotics to parts storage area -		Control console, SS computer, robotics, CCTV		0:05					
4.1.4.4.2.3	Translate robotics to work site		Control console, SS computer	-	0:05					
4.1.4.4.2.4	Conduct engine boroscope inspection.		Control console, SS computer, robotics, CCTV, boroscope	2	0:30	0:30			0:30	
4.1.4.4.2.5	Conduct thrust chamber Inspection		Control console, SS computer, CCTV, RMS		1:00	1:00			1:00	
4.1.4.4.2.6	Translate robotics to parts storage area. Secure unused parts		Control console, SS computer, robotics, CCTV		0:02					
4.1.4.4.2.7	Translate robotics to tool  storage area - secure  tools/effectors		Control console, SS computer, robotics, CCTV		0:05					
4.1.4.4.2.8	Translate robotics to storage area and secure		Control console, SS computer		0:05					

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			Constitute and a second		NIM.	Pagin Ciam	Pdan	MANUOIDE	
NIMBER	TASKT	PACILITIES	5	TRNG	Г	IVA	$\Box$	EVA TOTAL	AL REMARKS
4,1,4,4,3	Engine Remove and Replace	SS hanger, Control lighting, robotics power, effectol signal, protecti propeliant	console, SS computer, s, RMS, CCTV, tools/rs, special tools, lve covers	i '	5.30	3:35		<del>                                    </del>	3:35
4.1.4.4.3.1	Translate robotics to tool storage area - secure tools/effectors		Control console, SS computer, robotics, CCIV		0:05				
4.1.4.4.3.2	Translate robotics to parts storage - secure and store parts		Control console, SS computer, robotics, CCTV		0:05				
4.1.4.4.3.3	Translate robotics to work site		Control console, SS computer		0:02				
4.1.4.4.3.4	With engine removal tool disconnect engine from interface plate		Control console, SS computer, robotics, CCTV, special tool	8	0:40	0:40			0:40
4.1.4.4.3.5	Inflate engine removal tool		Control console, SS computer, robotics, GCTV	~	0:05	0:05		ö ——–	0:05
4.1.4.4.3.6	Remove engine with robotics		Control console, SS computer, CCTV, robotics, special tool	7	0:05	0:02			0:05
4.1.4.4.3.7	Translate RMS to work site; Attach grapple; disengage removal tool		Control console, SS computer, robotics, RMS, CCTV,	8	0:10	0:10			0:10
4.1.4.4.3.8	Translate RMS to parts storage area and secure unserviceable engine	نته جلسه بينين خشته ک	Control console, SS computer, RMS, CCTV,	~	0:15	0:15		<u> </u>	0:15
4.1.4.4.3.9	Translate robotics to parts storage area; unpackage replacement engine		Control console, SS computer, robotics, CCTV,	~	0:15	0:15		<del></del>	0:15
4.1.4.4.3.10	Conduct visual inspection	. ——	CCTV, robotics	7	0:05	0:05		<u>-</u> -	0:05
4.1.4.4.3.11	Attach RMS to engine grapple; translate RMS to work site		Control console, SS computer, CCTV, robotics	8	0:15	0:15		0 ————	0:15
			A-54				M	RTI	MARTIN MARIETTA

MARTIN MARIETTA

OTV POSTMISSION PROCESSING - CRYOGENIC

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eboureace			DECHTOEMENT		F	FILM	Tagila Cipper	MANITOTE	2
NUMBER	TASK	FACILITIES	TOOLS	8	TRNC	11	IVA E	EVA TOTAL	AL REMARKS
4.1.4.4.3.12	Translate robotics to Work site; secure removal tool		Control console, SS computer	SS computer	τ	0:05		 	
4.1.4.4.3.13	Install engine removal tool; Inflate support mechanism		Control console, SS computer, robotics, CCTV, special tool	SS computer, pecial tool	~	0:10	0:10	 ö 	0:10
4.1.4.4.3.14	Position robotics for installation		Control console,	SS computer		0:02		 	
4.1.4.4.3.15	Release RMS from engine grapple		Control console,	SS computer,	7		- <del></del> -	 	
4.1.4.4.3.16	Verify engine alignment with interface	<b>-</b>	Control console, SS computer, robotics, CCTV, special tool	SS computer,   pecial tool	~	0:05	0:02	 . <del>-</del>	0:05
4.1.4.4.3.17	Complete installation verify locking mechanisms are secured		Control console, SS computer, robotics, CCTV, special tool	SS computer, pecial tool	7	0:40	0:40	 	0:40
4.1.4.4.3.18	Disengage engine removal tool		Control console, robotics, CCTV	SS computer,	~	0:05	0:05	 - <del>-</del>	0:05
4.1.4.4.3.19	Engine check and verify		Control console, SS computer, CCTV	SS computer,	7	1:30	0:20	 	0:20
4.1.4.4.3.20	Translate RMS to parts storage area and secure unserviceable engine at grapple fixture		Control console, SS computer, RMS, CCIV	SS computer,	~	0:05	0:02	 ö 	
4.1.4.4.3.21	Translate robotics to tool storage area and secure engine removal tool		Control console, robotics, CCTV	SS computer,		0:05		 	
4.1.4.4.3.22	Translate robotics to parts storage area. Install protective covers on unserviceable engine; prepare for shipment		Control console, SS computer, robotics, CCTV	SS computer,		0:20	0:20	 . — — — — — — — — — — — — — — — — — — —	0:20 Return to earth
4.1.4.4.3.23	Store and secure engine with RMS following protective cover installation		Control console, SS computer, robotics, CCTV, protective covers	SS computer, rotective	7	0:05	0:05	 . <del>-</del>	1 50:0
4.1.4.4.3.24	Store and secure RMS		Control console, SS computer A-55	SS computer A-55	- <del></del>	0:05		 	Accomplished in conjunction with 4.1.4.4.3.25

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OTV POSTMISSION PROCESSING - CRYOGENIC

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SEOHENCE			REGUIREMENTS		FUNC CREW SUPPT	CREW	SUPPT	MANHOURS	OURS	
MIMBER	TASE	PACTLITIES		TRNG	TIME	IVA	EVA	EVA	TOTAL	REMARKS
Molitaria										
4.1.4.4.3.25	Store and secure additional		Control console, SS computer,	-	0:10					
	replacement parts carried by robotics		robotics, CCIV							
4.1.4.4.3.26	Translate robotics to tool		Control console, SS computer, I robotics, CCTV		0:05					
	tools/effectors						<u></u>			
4.1.4.4.3.27	Translate robotics to storage area and secure		Control console, SS computer		0:05					
	-			_		_	_	_	-	

	REMARKS	· .						Correct anomalies		
L								0:10   Correc		
MANHOURS	TOTAL		06:30	0:50				 		
-	A EVA									
CREW SUPPT	IVA   EVA		08	0:20				0:10		. —
FUNC			01:10	0:50	0:05	0:02	0:20	0::0 0::0	0:02	0:02
	TRNG			2				7		
REOUIREMENTS	TOOLS	·	SS hanger, Control console, SS computer, 11ghting, robotics, CCTV, special power, equipment signal, propellant umblifcals	SS computer, software	SS computer, software, robotics, CCTV	SS computer, software	Control console, SS computer, inspection equipment, CCTV, robotics	Control console, SS computer	Control console, SS computer, robotics, CCTV	Control console, SS computer
	PACILITIES		SS hanger, lighting, power, signal, propellant		· · · · · · · · · · · · · · · · · · ·					
	TASK	Aerobrake Scheduled Maintenance	Aerobrake Inspection	Analyze post mission telemetry data	Translate robotics to tool storage area; secure tools/ effectors	Translate robotics to aerobrake work site	Conduct aerobrake inspection	Verify inspection data	Translate robotics to tool area-secure tools	Translate robotics to storage area and secure
SEOHENCE	NUMBER	4.1.4.5	4.1.4.5.1	4.1.4.5.1.1	4.1.4.5.1.2	4.1.4.5.1.3	4.1.4.5.1.4	4.1.4.5.1.5	4.1.4.5.1.6	4.1.4.5.1.7

SEOUPINCE			REGITREMENTS		FUNC	CREW SUPPT	PPT T	MANHOURS	<u> </u>	
NUMBER	TASK	FACILITIES	TOOLS	TRNG		IVA	1 1	EVA IT	TOTAL REMARKS	S
4.1.4.5.2	Remove and Replace Aerobrake and Support	SS hanger, lighting, power, signal, propellant	SS hanger, Control console, SS computer, lighting, robotics, RMS, CCTV, tools/power, effectors, special tools signal, LRU's, leak detection propellant equipment	1	4:25	3:50		·	3:50	
4.1.4.5.2.1	Translate RMS to aerobrake work site and attach to grapple fixture		Control console, SS computer	# 	0:05	0:05			0:05	
4.1.4.5.2.2	Translate robotics to tool area; secure and store required tools/effectors	<b></b>	Control console, SS computer, robotics, CCIV		0:05					
4.1.4.5.2.3	Translate robotics to parts storage area; secure and store replacement hardware		Control console, SS computer, Irobotics, CCIV		0:05				. ————	
4.1.4.5.2.4	Translate robotics to serobrake work site		Control console, SS computer		0:05					
4.1.4.5.2.5	Disconnect RCS propellant/ electrical interfaces		Control console, SS computer, robotics, CCIV		0:20	0:20			0:20	
4.1.4.5.2.6	Disconnect aerobrake and support from support		Control console, SS computer, robotics, CCIV	2	0:15	0:15			0:15	
4.1.4.5.2.7	Translate RMS and robotics from work site to storage area; secure unserviceable aerobrake and support		Control console, SS computer, RMS, CCTV	~	0:50	0:20	. — — — —		0:20	
4.1.4.5.2.8	Assemble aerobrake and support with RMS and robotics		Control console, SS computer, RMS, robotics, CCTV	2	0:30	0:30			0:30	
4.1.4.5.2.9	Translate RMS and robotics to work site with replacement aerobrake and support		Control console, SS computer	8	0:20	0:20			0:20	
4.1.4.5.2.10	Inspect aerobrake support ring and RCS propellant/ interfaces		Control console, SS computer, robotics, CCTV	8	0:15	0:15			0:15	
								-	-	F

OTV POSTMISSION PROCESSING - CRYOGENIC

CEOMENCE			PENERATION		Jalia	2 120	CHIPPT	MANHOIRS	See
NUMBER	TASK	PACILITIES		TRMG	TIME	IVA	1 1	EVA TO	TOTAL   REMARKS
4.1.4.5.2.11	Align aerobrake and support		Control console, SS computer, robotics, RMS, CCTV	2	0:10	0:10			0:10
4.1.4.5.2.12	Attach aerobrake and support to support ring, verify mechanical attachments are secure		Control console, SS computer, RMS, robotics, CCTV	~	0:10	01			0:10
4.1.4.5.2.13	Verify RCS propellant/  electrical interfaces are  seated		Control console, SS computer,  robotics, CCTV	~	0:10	0:10			0:10
4.1.4.5.2.14	Attach RCS test equipment		Control console, SS computer, robotics, CCTV, test equipment		0:15	0:15			0:15
4.1.4.5.2.15	Pressurize RCS propellant spheres		Control console, SS computer		0:02				
4.1.4.5.2.16	Conduct RCS propellant  leak check		Control console, SS computer, leak detector equipment	~	0:15	0:15			0:15
4.1.4.5.2.17	Disconnect test equipment		Control console, SS computer, robotics, CCTV	7	0:15	0:15			0:15
4.1.4.5.2.18	Depressurize RCS propellant spheres		Control congole, SS computer	7	0:02				
4.1.4.5.2.19	Translate RMS to storage area and secure		Control console, SS computer	<del>-</del>	0:02				
4.1.4.5.2.20	Translate robotics to parts storage area and secure parts		Control console, SS computer, robotics, CCTV		0:02				
4.1.4.5.2.21	Disassemble unserviceable aerobrake; package for shipment		Control console, SS computer,  robotics, CCTV, tools/  effectors		0:30	0:30			0:30 Return to earth
4.1.4.5.2.22	Translate robotics to tool storage area and secure tools/effectors		Control console, SS computer, robotics, CCTV		0:02				
4.1.4.5.2.23	Translate robotics to storage area and secure		Control console, SS computer		0:05				
		_	A-59	.•			M	1877	MARTIN MARIETTA

SEQUENCE			REQUIRE			H	-1	_	MANHOURS	C S G A M C C
NUMBER	TASK	FACILITIES	TOOLS	TRING	NC TIME	YA]	A EVA	EVA	TOTAL	KETEKKO
4.1.5	Perform unacheduled Maintenance									
4.1.5.1	Propellant Tank Unscheduled Maintenance		·			<u></u>				
4.1.5.1.1	Remove and Replace Propellant Tank	SS hanger, lighting power, signal, propellant umbilicals	SS hanger, Control console, SS computer, lighting test equipment, robotics, power, tools/effectors signal, propellant	ics, -	3:00		2:20		2:20	
4.1.5.1.1.1	Translate robotics to tool area; secure & store tools/effectors		Control console, SS computer,	omputer, 1	0:02	<del></del>				
4.1.5.1.1.2	Translate robotics to work site	····	Control console, SS co	computer   1	0:02					
4.1.5.1.1.3	Translate RMS to work site and attach propellant tank grapple fixture		Control console, SS computer, RMS, CCTV	omputer, 2	0:10		0:10		0:10	
·4.1.5.1.1.4	Release tank at attaching Point 1		Control console, SS co  robotics, CCTV	SS computer, 2	0:15		0:15		0:15	
4.1.5.1.1.5	Release tank at attaching Point 2		Control console, SS co  robotics, CCTV	SS computer, 2	0:10		0:10		0:10	
4.1.5.1.1.6	Translate robotics from		Control console, SS computer	omputer 1	i 		- <del></del> -	. — — — -	·	This creates a clear path for the propellant tank when removed by RMS'
4.1.5.1.1.7	Remove tank with RMS		Control console, SS co	SS computer, 2	0:02		0:02		0:02	
4.1.5.1.1.8	Translate RMS to parts storage area and secure unserviceable tank		Control console, SS co	computer, 2	0:50		0:20		0:50	
4.1.5.1.1.9	Inspect tank interfaces with robotics; replace or repair any damaged components prior to tank installation		Control console, SS computer, CCTV, parts kit (as required)	omputer,   2 equired)   	0:50		0:50		0:50	
4.1.5.1.1.10	Translate RMS with service-		Control console, SS computer,	omputer,   2	0:20		0:20	-	0:20	
	able tank to work site		A-60				7	MAR	MILL	MARTIN MARIETTA

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OTV POSTMISSION PROCESSING - CRYOGENIC

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avnativas							-		
NUMBER	TASK	PACILITIES	REQUIREMENTS TOOLS	TRNC	TIME	IVA EVA	- E	MANHOURS A TOTAL	REMARKS
4.1.5.1.3	Transducer Replacement	SS hangar, lighting, power, signal propellant	Control console, SS computer, CCTV, robotics, LRU, tools/effectors, test equipment		2:05	1:15		1:15	
4.1.5.1.3.1	Translate robotics to tool area - secure tools/ effectors and test equipment		Control console, SS computer, robotics, CCTV		0:05				
4.1.5.1.3.2	Translate robotics to parts storage area and secure replacement transducer		Control console, SS computer,   robotics, CCTV		0:02				
4.1.5.1.3.3	Translate robotics to work site		Control console, SS computer		0:05				
4.1.5.1.3.4	Remove unserviceable transducer and store		Control console, SS computer, robotics, CCTV, tools/	8	0:20	0:20		0:20	
4.1.5.1.3.5	Install serviceable transducer		Control console, SS computer, tobotics, CCTV, tools/	2	0:20	0:50		0:20	
4.1.5.1.3.6	Install/checkout & calibrate transducer test equipment		Control console, SS computer, CCTV, robotics, test	8	0:15	0:15		0:15	
4.1.5.1.3.7	Conduct transducer checkout		Control console, SS computer, CCTV, robotics,		0:15				Correct anomolies
4.1.5.1.3.8	Disconnect & store test		Control console, SS computer, CCTV, robotics,	8	0:15	0:15		0:15	
4.1.5.1.3.9	Translate robotics to parts ares; package unserviceable transducer		Control console, SS computer, CCTV, robotics,		0:15	0:15		0:15 R	Return to earth
4.1.5.1.3.10	Translate robotics to tool area - secure tools and test equipment		Control console, SS computer, I robotics, GCTV		0:02				
4.1.5.1.3.11	Translate robotics to storage area and secure		Control console, SS computer   A-63		0:02	_	77.	77177	MARTIN MARIETTA

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SEQUENCE		OH 4 00 7 15	REQUIREM	Olyman	FUNC	CREW SUPPT		EVA TOTAL	SS BEMARKS
NUMBER	IASK	FACILITIES	10013	IKE	T THE	Т		ı	- -
4.1.5.1.4	Remove and Replace PU or TVS	SS hangar, lighting, power, signal, propellant	Control console, SS computer, robotics, CCTV, tools/ effectors, PU or TVS LRUs, test equipment		2:10	11:30			
4.1.5.1.4.1	Translate robotics to tool area - secure tools/effectors and test equipment		Control console, SS computer, robotics, CCTV, tools/effectors		0:02				
4.1.5.1.4.2	Translate robotics to parts storage area secure PU or TVS LRUs		Control console, SS computer,  robotics, CCTV, PU or TVS LRU  effectors	Ru - 1	0:02				
4.1.5.1.4.3	Translate robotics to work site		Control console, SS computer		0:02				
4.1.5.1.4.4	Remove PU or TVS		Control console, SS computer,  robotics, CCTV, tools/  effectors	r,	0:20	0:20			0:20
4,1,5,1,4,5	Install new PU or TVS	·.	Control console, SS computer,  robotics, CCIV, tools/  effectors	r,	0:20	0:20	·		0:20
4.1.5.1.4.6	Install/checkout/calibrate PU or TVS test equipment		Control console, SS computer,   Irobotics, CCTV, test   equipment	r,	0:15	10:15			0:15
4.1.5.1.4.7	Conduct PU or TVS checkout		Control console, SS computer	- <del>-</del> -	0:15				Correct anomalies
4.1.5.1.4.8	Disconnect and store test equipment in robotics		Control console, SS computer, robotics, CCTV	r,	0:15	0:15		- <del></del> -	0:15
4.1.5.1.4.9	Translate robotics to parts area, package unserviceable PU or TVS		Control console, SS computer,     robotics, CCTV		0:20	0:20			0:20 Return to earth
4.1.5.1.4.10	Translate robotics to tool area - secure tools/effectors and test equipment		Control console, SS computer,  robotics, CCTV	r, 	0:02				- <del></del>
4.1.5.1.4.11	Translate robotics to storage area and secure		Control console, SS computer	<del></del> -	0:02				
	_	<b>.</b>	~	_	-	_			MARTIN MARIETTA

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CECUIENCE			PEOUTPEMENTS		FIINC	CREW S	UPPT	FIINC CREW SUPPT   MANIOURS		
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	IVA	EVA	TRNG TIME IVA EVA EVA TOTAL	L REMARKS	
4.1.5.1.5	Tank Reconfiguration  NOTE: LO2 tank remove and replace will follow LH2 procedures once antennas are removed (see 4.1.5.1.1)		Control console, SS computer, robotics, RMS, CCIV, tools/ effectors, propellant tank(s), test equipment		3:00	2:20			2:20   3:00 hrs/tank	·
	_	<b>-</b>		<u>-</u>		_	_	-	_	

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SEQUENCE			REQUIREMENTS		FUNC	CREW S		3	
NUMBER	TASK	PACILITIES		TRNG	11		EVA EVA	A TOTAL	L REMARKS
4.1.5.2	Avionics Unscheduled Maintenance								
4.1.5.2.1	Module Replacement	SS hangar, lighting, aignal, power, propellant	SS hangar, Control console, SS computer, lighting, CCTV, robotics, tools/ signal, effectors, test equipment power, propellant pumblificals		1:50	0:55		0:55	
4.1.5.2.1.1	Translate robotics to tool area; secure tools/effectors		Control console, SS computer, robotics, CCTV		0:05				
4,1,5.2,1.2	Translate robotics to parts storage; secure replacement module		Control console, SS computer, robotics, CCTV		0:05				
4.1.5.2.1.3	Translate robotics to work site	. — — —	Control console, SS computer, robotics, CCTV		0:05				
4.1.5.2.1.4	Remove and store avionics module		Control console, SS computer, robotics, CCTV, tools/effectors	2	0:15	0:15		0:15	
4.1.5.2.1.5	Inspect module mounting interface for defects	~	Control console, CCTV, robotics	7	0:02	0:05		0:05	5
4.1.5.2.1.6	Install replacement module		Control console, SS computer,  robotics, CCTV, tools/  effectors	~	0:15	0:15		0:15	
4.1.5.2.1.7	Conduct module test/checkout		Control console, SS computer		0:30				Correct anomalies
4.1.5.2.1.8	Translate robotics to parts storage; package unservice-able module		Control console, SS computer,  robotics, CCTV		0:20	0:20		0:50	0 Return to earth
4.1.5.2.1.9	Translate robotics to tool storage area; secure tools/effectors		Control console, SS computer, robotics, CCTV		0:05				
4.1.5.2.1.10	Translate robotics to storage and secure		Control console, SS computer		0:05				

OTV POSTMISSION PROCESSING - CRYOGENIC

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SEQUENCE			REDITREMENTS			CREW SUPPT	Tddi	MANHOURS	
NUMBER	TASK	FACILITIES		TRNC	TIME	IVA	П	EVA   TOTAL	REMARKS
4.1.5.2.2	Remove and replace GPS Antenna System	SS hangar, lighting, power, signal, propellant umbilicals	SS hangar, Control console, SS computer, lighting, tools/effectors, robotics, power, CCTV, LRU's signal, propellant		2:35	1:40		1:40	S-Band antenna is mounted   on octagonal avionics   assembly
4.1.5.2.2.1	Translate robotics to tool area; secure tools/effectors and test equipment		Control console, SS computer, robotics, CCTV		0:02		<del></del>	- <del></del>	· ·
4.1.5.2.2.2	Translate robotics to parts storage area - secure and store replacement parts		Control console, SS computer, robotics, CCTV		0:05				
4.1.5.2.2.3	Translate robotics to work site		Control console, SS computer	- <del></del>	0:05				
4.1.5.2.2.4	Disconnect GPS antenna cabling	~	Control console, SS computer, robotics, CCIV, tools/	~~~~	0:10	0:10		0:10	
4.1.5.2.2.5	Disconnect GPS cable retaining devices if attach to tank		Control console, SS computer, robotics, CCTV, tools/ effectors	~ ~ ~ ~ ~	0:15	0:15		0:15	. <del></del>
4.1.5.2.2.6	Disconnect, remove and store GPS antenna system		Control console, SS computer, robotics, CCTV, tools/		0:20	0:20		0:50	
4.1.5.2.2.7	Install GPS antenna system	· — ·	Control console, SS computer, robotics, CCTV, tools/	~	0:20	0:20	· <del>· · · · · · · · · · · · · · · · · · </del>	0:50	
4.1.5.2.2.8	Reattach RF cabiing		Control console, SS computer, robotics, CCIV, tools/	~~~~	0:15	0:15		0:15	
4.1.5.2.2.9	Conduct test on GPS antenna system		Control console, SS computer, test equipment	- <b></b> -	0:30				Correct anomalies
4.1.5.2.2.10	Translate robotics to parts storage area; package GPS antenna system		Control console, SS computer, robotics, OCTV		0:20	0:20		0:5	0:20 Return to earth
	•	_	A-67	_	_		MA	RTII	MARTIN MARIETTA

OTV POSTMISSION PROCESSING - CRYOGENIC

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SEOUENCE			REQUIREMENTS		FUNC	CREWS	UPPT	MANHO	IRS	
NUMBER	I TASK	FACILITIES	TOOLS	TRNG	TIME	IVA	EVA	TRNG TIME I IVA EVA EVA TOTAL	TAL	REMARKS
4.1.5.2.2.11	Translate robotics to tool storage area and secure tools		Control console, SS computer, robotics, CCIV	- T	0:05					
4.1.5.2.2.12	Translate robotics to storage area and secure	· ·	Control console, SS computer		0:05					

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SEQUENCE			REQUIREMENTS		FUNC		SUPPT	MANHOURS	URS	
NUMBER	TASK	PACILITIES	TOOLS	TRING	TIME	IVA	EVA	EVA	TOTAL	REMARKS .
4.1.5.3	Unscheduled RCS Maintenance									
	- TBD									
4.1.5.4	Unscheduled Engine Maintenance-TBD									

OTV POSTMISSION PROCESSING - CRYOGENIC

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SEOUENCE			D DOLLYD EMENERO		9		H	041001	
NUMBER	TASK	FACILITIES		TRNC	TIME	IVA EVA	- -	VA TOTAL	REMARKS
4.1.5.5	Remove and Replace Turbopump	SS hanger, signal, power,			4:40	3:30		3:30	4:40/Turbopump
4.1.5.5.1	Translate robotics to tool area - secure and stow tools/effectors and special removal tools	Propeilant umbilical 11ghting	Control console, SS computer,		0:05		<del></del>		
4.1.5.5.2	Translate robotics to parts area - secure and stow replacement turbopump		Control console, SS computer,		0:05				
4.1.5.5.3	Translate robotics to work site		Control console, SS computer, ICCTV		0:02				
4.1.5.5.4	Install turbopump Installation tools		Control console, SS computer, CCTV, tools/effectors, special tools	~	0:50	00:50		0:50	
4.1.5.5.5	Disconnect turbopump		Control console, SS computer, CCTV, tools/effectors,	8	0:10	0:10		0:10	
4.1.5.5.6	Remove turbopump		Control console, SS computer, CCTV, tools/effectors,	7	0:30	0:30		0:30	
4.1.5.5.7	Install turbopump Installation tools		Control console, SS computer, CCTV, tools/effectors,	7	0:45	0:45		0:45	
4.1.5.5.8	Position turbopump and connect		Control console, SS computer, CCIV, tools/effectors,	7	0:10	0:10		0:10	
4.1.5.5.9	Remove installation tools		Control console, SS computer, CCTV, tools/effectors,	7	0:20	0:20		0:20	
4.1.5.5.10	Connect checkout equipment		Control console, SS computer, CCTV, tools/effectors, special tools	~	0:15	0:15		0:15	
4.1.5.5.11	Conduct leak check and electrical check		Control console, SS computer, test equipment		0:40				Correct anomalies
4.1.5.5.12	Remove checkout equipment		Control console, SS computer, CCTV	8	0:15	0:15		0:15	
4.1.5.5.13	Translate robotics to parts area		Control console, SS computer, CCTV A-70		0:05		A B	7//	MARTIN MARIETTA

OTV POSTMISSION PROCESSING - CRYOGENIC

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CECHENCE			REOUTREMENTS		FUNC	CREW S	UPPT	FUNC CREW SUPPT   MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TRNC TIME IVA EVA	IVA		EVA TOTAL	AL REMARKS
4.1.5.5.14	Package turbopump for shipment		Control console, SS computer, CCIV, tools/effectors,		0:15  0:15	0:15		- <del></del> -	0:15 Return to earth
4.1.5.5.15	Translate robotics to tool area - secure tools		Control console, SS computer		0:05		. — <del></del>		
4.1,5.5.16	Secure robotics		Control console, SS computer		0:05		. —— —		
	_	-		-	-	•	•	-	-

OTV POSTMISSION PROCESSING - CRYOGENIC

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Militaria			REQUIRE	_ [	FUNC	2		5	- į
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	IVA E	EVA EVA	A TOTAL	I. REMARKS
4.1.5.6	Aerobrake Unscheduled Repair	SS Hangar, lighting, power, signal, umbilicals	Control console, SS computer, robotics, CCTV, repair kit, special tools		3:05	2:30		<u> </u>	
4.1.5.6.1	Translate robotics to tool storage area; secure tools/effectors		Control console, SS computer, robotics, CCTV		0:05				- <del></del>
4.1.5.6.2	Translate robotics to parts storage area; secure repair kit		Control console, SS computer,  robotics, CCTV		0:02			·	
4.1.5.6.3	Translate robotics to aerobrake work site		Control console, SS computer		0:05				
4.1.5.6.4	Verify damaged area is within prescribed repairable tolerance	·	Control console, SS computer, robotics, CCTV, measuring tool	~	0:10	0:10		0:10	
4.1.5.6.5	Prepare area for repair		Control console, SS computer,  robotics, CCTV, tools	~	0:30	0:30		0:30	0
4.1.5.6.6	Complete repairs		Control console, SS computer, robotics, CCTV, tools	~	1:20	1:20		1:20	
4.1.5.6.7	Verify curing/setup requirements		SS computer		0:02				
4.1.5.6.8	Conduct required repair test		Control console, SS computer, CCTV, robotics	2	0:30	0:30		0:30	0 Visual, pull, etc.
4.1.5.6.9	Translate robotics to parts storage area		Control console, SS computer, robotics, CCTV,		0:05				
4.1.5.6.10	Translate robotics to tool storage area, secure tools/effector		Control console, SS computer, robotics, CCTV,		0:05			- <del></del>	
4.1.5.6.11	Translate robotics to storage area and secure		Control console, SS computer,		0:05	<del></del>			

OTV POSTMISSION PROCESSING - CRYOGENIC

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	TASK	FACILITIES		TRNC	FUNC	CREW	SUPPT	EVA TOTA		REMARKS	
Contr	Remove and Replace GHe, GO2 or GH2 Regulator Control Package	SS hangar, lighting, signal, power, propellant	SS hangar, Control console, SS computer, lighting,   robotics, CCTV, special signal,   tools/effectors, LRU's, power,   test equipment propellant   umbilicals	rer.	2:30	1:45			1:45	•	
Tran ston ston	Translate robotics to tool storage area, secure and store tools/effectors		Control console, SS computer, robotics, CCTV	iter,   1	0:02						
Tra sto	Translate robotics to parts storage area, secure and store required LRU's		Control console, SS computer, robotics, CCTV	iter, 1	0:02						
Tran	Translate robotics to work		Control console, SS computer	iter   1	0:02						
Rel uns con	Release and remove unserviceable regulator/ control package and store		Control console, SS computer, robotics, CCTV, tools/ effectors	iter,   2	0:30	0:30					
Ins	Inspect regulator/control package interface; repair as required		Control console, SS computer, robotics, CCTV	iter,   2	0:02	0:02			50:0		
A11	Align and install regulator control package		Control console, SS computer, robotics, CCTV	iter,   2	0:30	0:30			0:30		
Ver	Verify mechanical interfaces are secure		Control console, SS computer, robotics, CCTV	iter,   2	0:02	0:02			0:05		
Ins	Install leak detection equipment		Control console, SS computer, robotics, CCTV	iter,   2	0:10	0:10			0:10		
Pre 8y8	Pressurize appropriate system		Control console, SS computer	iter   2	0:15	. –			Correct anomolies	olies	
Pe	Depressurize system		Control console, SS computer	iter   2	0:05						
Rem	Remove leak detection equipment		Control console, SS computer, robotics, CCTV	iter,   2	0:10	0:10			0:10		
Tra	Translate robotics to parts storage area; package		Control console, SS computer, robotics, CCTV	lter,   1	0:15	0:15			0:15 Return to earth	ırth	
<b>8</b> 05	unserviceable components		A-73				724	RT	MARTIN MARIETTA	777	

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SEQUENCE			REQUIREMENTS		FUNC	CREW S	UPPT	FUNC   CREW SUPPT   MANHOURS	IRS	
NUMBER	I TASK	PACILITIES	TOOLS	TRNG	TIME	IVA	EVA	TRNG   TIME   IVA   EVA   TOTAL	TAL	REMARKS
4.1.5.7.13	  Translate robotics to tool		Control console, SS computer,		0:05					
	storage area; secure		robotics, CCTV							
415716	Translate robotice to		Control console SS commiter		0:05					
	storage area and secure									

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SEQUENCE			REGITTREMENTS			FINC	CREW SIIPPT	L Lddl	MANHO	IRS	
NUMBER	TASK	FACILITIES			TRNC	П	IVA		EVA   TOTAL	OTAL	REMARKS
4.1.5.8	Remove and Replace GHe,	SS hangar lighting, aignal, power, propellant	Control console, CCTV, robotics, Lools, test equi	SS computer, special pment	1	2:10	1:25			1:25	
4.1.5.8.1	Translate robotics to tool storage area, secure and store tools/effectors		Control console, SS computer,	computer,		0:02					
4.1.5.8.2	Translate robotics to part storage area, secure and store required IRUs		Control console, SS computer, CCIV, robotics	computer,		0:05					
4.1.5.8.3	Translate robotics to the designated work site		Control console, SS computer	computer	- <del>-</del>	0:05					
4.1.5.8.4	Release, remove and store unserviceable sphere		Control console, SS corrobotics, CCIV, tools/effectors	computer,	~	0:20	0:20	<del>-</del> _		0:20	
4.1.5.8.5	Inspect interface area for damage, repair as necessary		Control console, SS robotics, CCTV	computer,	~	0:05	0:02			0:05	
4.1.5.8.6	Align and install replacement sphere		Control console, SS computer, robotics, CCTV, tools/effectors	SS computer, tools/	~	0:20	0:20			0:50	
4.1.5.8.7	Verify mechanical interfaces are seated		Control console, SS computer, robotics, CCTV	computer,	7	0:05	0:02		<u> </u>	0:05	
4.1.5.8.8	Attach leak detection equipment		Control console, SS corobotics, CCIV, tools/effectors	computer,	~	0:10	0:10			0:10	
4.1.5.8.9	Pressurize sphere		Control console, SS	computer		0:15				<u> </u>	Correct anomolles
4.1.5.8.10	Depressurize sphere		Control console, SS	SS computer		0:05					
4.1.5.8.11	Remove leak detection equipment		Control console, SS   robotics, CCTV	SS computer,	7	0:10	0:10			0:10	

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SEMIENCE			REQUIREMENTS		FUNC	CREW SI	PPT	CREW SUPPT   MANHOURS	URS	
MIMBER	TASK	PACTLITIES	TOOLS	TRNG	TIKE	IVA EVA	_	EVA T	TOTAL	REMARKS
MOTIBLE					-	-	-		-	
4.1.5.8.12	Translate robotics to parts	_	Control console, SS computer,   1		0:15 0:15	0:15			0:15	0:15   Return to earth
	storage area; package unserviceable components		robotics, CCTV							
		_		_	_				_	
4.1.5.8.13	Translate robotics to tool	_	Control console, SS computer,	_ _	0:05					
	storage area; secure		robotics, CCIV							
	tools/effector								_	
4.1.5.8.14	Translate robotics to		Control console, SS computer,	_	0:05				_	
	storage area and secure									,

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MARTIN MARIETTA REMARKS 0:10 0:20 0:10 0:10 0:30 0:20 EVA TOTAL 0:10 2:40 CREW SUPPT EVA 0:10 0:10 10:20 10:10 0:50 0:10 0:30 2:40 IVA 0:20 0:10 0:20 0:10 0:10 4:00 0:05 0:05 0:05 0:10 0:30 0:05 FUNC TRNC --8 7 7 ~ ~ ~ 7 ~ Control console, SS computer, Control console, SS computer, Control console, SS computer, CCIV, RMS Control console, SS computer, Control console, SS computer, SS hangar, Control console, SS computer, lighting, |robotics, RMS, CCTV, Tools/power, |effectors, test equip, IRU's Control console, SS computer, robotics, CCTV Control console, SS computer, Control console, SS computer, CCTV Control console, SS computer, CCTV, robotics, tools/ Control console, SS computer robotics, CCTV Control console, SS computer A-77 RMS, CCTV, robotics TOOLS REQUIREMENTS CCTV, robotics CCTV, robotics effectors CCTV, RMS PACILITIES | umbilicals power, signal, store required parts Translate payload interface system to work site Install and secure payload Remove and Replace Payload Interface System Translate robotics to work Translate RMS to work site Secure serviceable payload interface system with RMS franslate robotics to tool Inspect payload interface Release payload interface system interface system to parts area and secure mounting area; repair as interface system grapple storage area; secure and Align payload interface system with RMS and attach to payload unserviceable payload Remove and translate store tools/effector interface system TASK necessary fixture 4.1.5.9.10 4.1.5.9.11 4.1.5.9.2 4.1.5.9.9 4.1.5.9.3 4.1.5.9.5 4.1.5.9.6 4.1.5.9.7 4.1.5.9.8 4.1.5.9.1 4.1.5.9.4 SEQUENCE 4.1.5.9 NUMBER

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SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	PPT	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TIME	IVA	EVA E	EVA   TOTAL	REMARKS
4.1.5.9.12	Install test equipment		Control console, SS computer, CCTV, robotics	~~~	0:15  0:15	0:15		0:15	
4.1.5.9.13	Conduct system test		Control console, SS computer		0:45				Correct anomolies
4.1.5.9.14	Remove test equipment and store		Control console, SS computer, CCTV, robotics,	~	0:15	0:15 0:15		0:15	
4.1.5.9.15	Translate RMS to storage area and secure		Control console, SS computer		0:02				
4,1.5,9,16	Translate robotics to parts area, package unservicesble payload interface system		Control console, SS computer, CCIV, robotics,		0:20	0:20 0:20		0:20	0:20 Return to earth
4.1.5.9.17	Translate robotics to tool storage area; store tools/effectors		Control console, SS computer, CCIV, robotics,		0:05				
4.1.5.9.18	Translate robotics to storage area and secure		Control console, SS computer		0:05				

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	(KS						•				60		
	REMARKS	·		·							Correct anomolies		
MANHOURS	TOTAL	1:45				0:30	0:05	0:30	0:15				0:15
	EVA												
1	EVA	- میں <del>ک</del> میں سات سات امر											
CREV		2 1:45				0:30	0:02	0:30	5  0:15				0:15
FUNC		2:35	0:02	0:02	0:02	0:30	0:02	0:30	0:15	0:02	0:15	0:05	0:15
	TRNC	ı 			- <del>-</del>	~	7	~	~	7		~	~
REQUIREM	TOOLS	SS hangar, Control console, SS computer, 11ghting, tools/effectors, LRU's power, robotics, test equipment signal, CCTV corperlant computers and consoling computers and consoling consolin	Control console, SS computer, tobotics, CCTV	Control console, SS computer,  robotics, CCTV	Control console, SS computer	Control console, SS computer, Irobotics, CCTV, tools/ effectors	Control console, SS computer, robotics, CCTV	Control console, SS computer, trobotics, CCTV, tools/	Control console, SS computer, Irobotics, CCIV,	Control console, SS computer	Control console, SS computer	Control console, SS computer	Control console, SS computer, Irobotics, CCTV
21010	FACILITIES	SS hangar, lighting, power, signal, propellant											
	TASK	Remove and Replace LO2 or LH2 Tank Pressure System	Translate robotics to tool storage area; secure and store tools/effectors	Translate robotics to parts storage area; secure and store LRU's	Translate robotics to work site	Detach, remove and store unserviceable tank press	Inspect tank press system interfaces	Align, install and secure serviceable tank press system	Install leak check equipment	Pressurize system	Conduct leak check	Depressurize tank press system	Disconnect and remove test equipment
SEQUENCE	NUMBEK	4.1.5.10	4.1.5.10.1	4.1.5.10.2	4.1.5.10.3	4.1.5.10.4	4.1.5.10.5	4.1.5.10.6	4.1.5.10.7	4.1.5.10.8	4.1.5.10.9	4.1.5.10.10	4.1.5.10.11

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SEQUENCE			REQUIREMENTS		FUNC	CREW	SUPPT	FUNC   CREW SUPPT   MANHOURS	OURS	
NUMBER	TASK	FACILITIES	STOOL	TRNC	TRNG TIME	IVA	EVA EVA	EVA	TOTAL	REMARKS
4.1.5.10.12	Translate robotics to part storage area; package unserviceable system		Control console, SS computer, robotics, CCTV		0:10	0:10 0:10			0:10	0:10 Return to earth
4.1.5.10.13	Translate robotics to tool storage area; store tools/effectors		Control console, SS computer, robotics, CCTV		0:02					
4.1.5.10.14	Translate robotics to storage area and secure		Control console, SS computer		0:02					

OTV POSTMISSION PROCESSING - CRYOGENIC

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SEQUENCE			REDITTREMENTS		PINC	Г	Caru cilpor	100	MANITOTIBE	30	
NUMBER	TASK	FACILITIES		<u>L</u>	TRNG TIME	П	IVA TE	EVA EVA		TOTAL	REMARKS
4.1.5.11	Core Structure Replacement	Hangar, 11ghting, power, signal, propellant	Control console, SS computer, robotics, RMS, CCTV, tools/ effectors, test equipment, LRU's, special tools	omputer, tools/	<del></del>	81:55   5 	50:10		<u> </u>	50:10	
4.1.5.11.1	Translate robotics to tool storage area, secure and store required tools/ effectors		Control console, SS computer, robotics, CCTV			0:0		. <del></del>			
4.1.5.11.2	Translate robotics to parts storage area, secure and store required LRU's		Control console, SS c robotics, CCIV	SS computer,	- <del>-</del>	0:02				:	
4.1.5.11.3	Translate robotics to designated work site		Control console, SS c	computer,	- <del></del> -	0:05					
4.1.5.11.4	Translate RMS to designated work site		Control console, SS computer,			0:05					
4.1.5.11.5	Remove payload interface system (see 4.1.5.9)		Control console, SS computer, RMS, robotics, CCIV, tools/ effectors		 	0:55	0:55			0:55	
4.1.5.11.6	Remove GPS antenna system (See 4.1.5.2.2)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors		- <del></del> -	0:30	0:30			0:30	
4.1.5.11.7	Remove octagonal avionics assembly modules (See 4.1.4.2.2)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors			7:00:7	7:00			7:00   21 Total m   per module	21 Total modules - 20 minutes per module
4.1.5.11.8	Remove propellant tanks - 4 ea (See 4.1.5.1.1)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors		- <del></del>	4:00	4:00			4:00 1 hour per tank	tank
4.1.5.11.9	Remove aerobrake and support (See 4.1.4.5.2)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors			1:00 1	1:00			1:00	
4.1.5.11.10	Remove engines (See 4.1.4.4.3)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors, special tool		2	2:50   2	2:50			2:50   1:25 hrs per engine	er engine
		_	A-81	1				MA	KY	MARTIN MARIETTA	IETTA

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OTV POSTMISSION PROCESSING - CRYOGENIC

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Install propellant tanks - 4 ea (See 4.1.5.1.1) (1 hr/tank) Install octagonal avionics assembly modules (See 4.1.5.2.2) Install GPS antenna system (See 4.1.5.2.2) Install payload interface system (see 4.1.5.2.2) Install payload interface system (see 4.1.5.9) Attach power, signal and propellant umbilicals Install and checkout Conduct subsystem and system checkout; correct anomalies Disconnect and store test equipment Translate RMS to storage area and secure Translate robotics to parts Storage area; store serviceable parts; package unserviceable parts	Control console, SS RNS, robotics, CCTV, effectors Control console, SS robotics, CCTV, Control console, SS robotics, CCTV, Control console, SS Control console, SS COTV, robotics Control console, SS	computer, 2 tools/ tools/ computer, 2 tools/ tools/ computer, 2 tools/ computer, 2 computer, 1 computer, 1 computer, 1 computer, 2 computer, 1	11HE 4:00 4:00 55 0:50 0:50 0:00 0:00 0:00 0	0:20   CREM SUPPT	_ <mark>B</mark>	A TOTAL 4:00 7:00 7:00 1:00 1:00 3:00	REMARKS Correct anomolies Return to earth
Translate robotics to tool storage area; store tools/ effectors	Control console, SS computer,  robotics, CCTV	uter, 1	0:02				
Translate robotics to storage area and secure	Control console, SS computer	uter   1	0:02				

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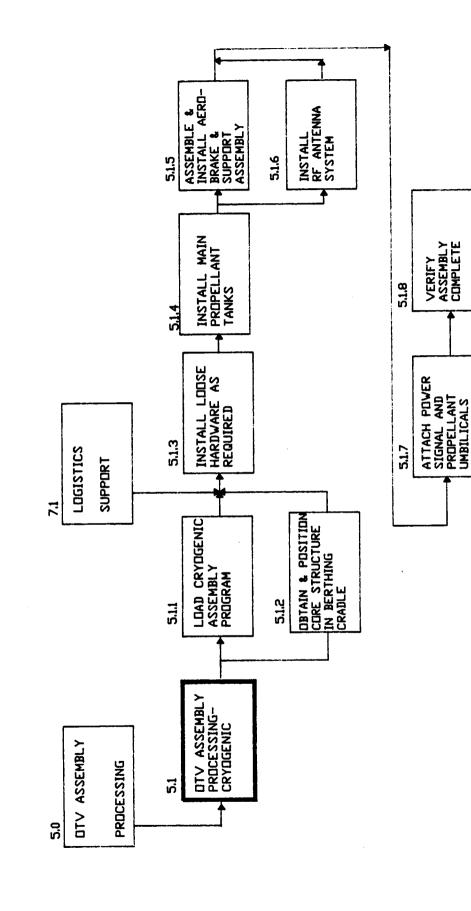
SEQUENCE			REQUIREMENTS		FUNC	FUNC CREW SUPPT	PPT	MANHOURS	URS 1
NUMBER	TASK	FACILITIES	TOOLS	TRNG TIME	TIME	IVA	EVA	EVA	TOTAL REMARKS
4.1.6	Verify Maintenance Complete				1:15 1:15	1:15			1:15
4.1.6.1	Verify all maintenance completed per maintenance plan		Control console, SS computer		0:15 0:15	0:15		. —— —-	0:15
4.1.6.2	Verify all anomalies corrected and diagnostic tests completed		Control console, SS computer		0:20   0:20	0:20			0:20
4.1.6.3	Verify OTV safed		Control console, SS computer		0:40 0:40	0:40			0:40
		_		_	_	_	_	-	_

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## CRYOGENIC SPACE-BASED OTV ASSEMBLY PROCESSING

The Cryogenic SBOTV is initially delivered to Space Station unassembled, requiring the equivalent of two Shuttle flights for the delivery. This functional flow and requirements definition set identifies the operations associated with initial assembly of the Cryogenic SBOTV.



			REQUIREMENTS		FUNC	FUNC   CREW SUPPT   MANIJOURS	SUPPT	MAM	OURS	
-	TASK	FACILITIES	TOOLS	TRNG TIME IVA EVA EVA TOTAL	TIME	IVA	EVA	EVA	TOTAL	REMARKS
		_		_				L		
	OTV Assembly Processing	SS hanger,		22:40	22:40 11:15	_	_	_	11:15	11:15  Components/parts will be
<u>. [</u>	ryogenic	11ghting,		_		_	_	_		unpacked and visually
		signal,		_	_	_	_	_	_	Inspected prior to transfer
		power,		_		_	_			to the processing area
								_		

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SEQUENCE NUMBER	TASK	FACILITIES	REQUIREMENTS TOOLS	TRNC	FUNC	CREW SUPPT	SUPPT	MANIJOURS EVA TOTA	IOURS TOTAL	REMARKS
5.1	OTV Assembly Processing	SS hanger.		122:40	22:40111:15	1	T -	·	11:15	Components/parts will be
	- Cryogenic	lighting, signal,								unpacked and visually inspected prior to transfer
		power, propellant umbilicals							<del></del>	to the processing area
5.1.1	Load Cryogenic Assembly Program		SS computer, control console		0:30	0:30		_ 으!	0:30	Task accomplished concurrently with core
5.1.1.1	  Verify correct program		Control console, SS computer		0:05	0:05 0:05	<b></b>		0:05	structure berthing
5.1.1.2	Verify all applicable OTV modifications are incorp- orated in assembly program	 	Control console, Ss computer		0:15	0:15			0:15	
5.1.1.3	Load and verify proper assembly operations				0:10	0:10   0:10			0:10	

OTV ASSEMBLY PROCESSING - CRYOGENIC

SHEET 2 OF 8

SEQUENCE			REQUIREMENTS		FUNC	FUNC CREW SUPPT		MANHOURS	
NUMBER	TASK	PACILITIES	TOOLS	TRNC	TRNG TIME	IVA	EVA   E	EVA   TOTAL	REMARKS
5.1.2	Obtain and Position Core Structure in Berthing Cradie		SS computer, control console, RMS, GCTV, robotics		1:00 1:00	1:00		1:0	1:00 Task accomplished concurrently with assembly program loading.
5.1.2.1	Translate OTV from storage area		SS computer, control console, RMS, CCTV	2	0:20  0:20	0:20		   0:20 	
5.1.2.2	Extend cradle interfaces and lock in place	·	SS computer, control console, robotics, CCTV	~~~~·	0:30 0:30	0:30			0:30 OTV cradle interfaces will be folded to meet cargo bay limitations
5.1.2.3	Position core structure in berthing cradic and secure		SS computer, control console, RMS, CCIV, robotics	~	0:10   0:10	0:10		0:10	
	_	_		_	_	_	_	_	

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SHEET 4 OF 8

SEQUENCE			RECHTREMENTS		FUNC	CREW SUPPT	Tadns	MANITOURS	URS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TIME	IVA	ПΓ	EVA 17	TOTAL	REMARKS
5.1.4	Install Main Propellant Tanks		SS computer, control console, CCTV, RMS, robotics, tools/effectors		4:10	4:10			4:10	Pour (4) tanks require intallation. 1 Hr/Tank
5.1.4.1	Translate RMS to parts storage area. Secure tank and translate to work site		SS computer, control console, CCIV, RMS	~	0:20	0:20			0:20	
5.1.4.2	Inspect tank interfaces With robotics prior to tank installation		SS computer, control console, CCIV, robotics	~	0:10	0:10			0:10	
5.1.4.3	Verify sufficient clearance between robotics and RMS with tank		SS computer, control console		 	 				
5.1.4.4	Position/align tank with OTV attaching points and insert onto tank interface		SS computer, control console, CCIV, robotics, RMS	~	0:10	0:10			0:10	
5.1.4.5	Secure tank at attaching point 2 with robotics		SS computer, control console, CCTV, robotics, RMS	~	0:10	0:10		- ***	0:10	
5.1.4.6	Secure tank at attaching point 1 with robotics		SS computer, control console, CCIV, robotics, RMS	~	0:10	0:10			0:10	
5.1.4.7	Release RMS from tank		SS computer, control console,		1	1			1	
5.1.4.8	Complete steps 5.1.4.1 thru 5.1.4.7 for remaining tanks		SS computer, control console, CCIV, robotics, RMS			·			1	
5.1.4.9	Install, checkout and calibrate leak detection equipment		SS computer, control console, CCIV, robotics	~	0:10	0:10			0:10	Pollowing last tank Installation
	•									

OTV ASSEMBLY PROCESSING - CRYOGENIC

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	REMARKS											
MANIFOLIDE	EVA TOTAL	2:00			0:10	0: 30	0:10	0:20		0:20		0:10
Taggin Class	EVA						 					 o
		2 2:00		- <u></u> -	0 0:10	0 0:30	0.0010	0:50		20 0:50		10 0:10
CHINIC	_	2:35	0:02	0:02	0:10	0:30	0:10	0:20	0:10	0:20	0:02	0:10
	TRNG	 	- 		~	~ 	~		~ 	~ 		
DENGINE BENEVIC	REQUIREMENTS TOOLS	hangar, SS computer, control console, hting, CCTV, robotics, RMS, tools nal, and effectors er,	SS computer, control console	SS computer, control console	SS computer, control console, RMS, CCIV	SS computer, control console, RMS, CCTV, robotics, tools/effectors	SS computer, control console, RMS, CCIV, robotics, tools/effectors	SS computer, control console, RMS, CCTV, robotics, tools/effectors	SS computer, control consule, CCTV, robotics, test equipment	SS computer, control console,  CCTV, RMS	SS computer, control console	SS computer, control console, RMS, robotics, CCTV, tools/ effectors
	FACILITIES	SS hangar, lighting, signal, power, umbilicals						<u> </u>				
	TASK	Assemble and Install Acrobrake and Support Assembly	Translate RMS to aerobrake storage area	Translate robotics to aerobrake storage area	Secure aerobrake for assembly	Unfold merobrake and support structure with robotics	Secure aerobrake support latches	Inject aerobrake outer ring With rigidizing compound	Conduct inspection of aerobrake, prior to installation on OTV	Translate RMS with assembled acrobrake to OTV processing area	Translate robotics to OTV processing area	Align and attach aerobrake and support to core structure
	SEQUENCE	5.1.5	5.1.5.1	5.1.5.2	5.1.5.3	5.1.5.4	5.1.5.5	5.1.5.6	5.1.5.7	5.1.5.8	5.1.5.9	5.1.5.10

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OTV ASSEMBLY PROCESSING - CRYOGENIC

SEQUENCE		Ŀ	REQUIREMENTS		FUNC	CREW SUPPT		MANHOURS	URS	
NUMBER	TASK	FACIL, ITIES	TOOLS	TRNG	TIME	IVA	EVA	EVA 1	TOTAL	REMARKS
5.1.5.11	Connect RCS propellant lines		SS computer, control console,	2	0:10 0:10	0:10			0:10	
			robotics, CCTV, tools/ effectors							·
5.1.5.12	  Connect RCS power and		SS computer, control console,	8	0:05 0:05	0:05	· <b></b>		0:05	
	signal lines		robotics, CCTV, tools/ effectors							
5.1.5.13	  Install, checkout and		SS computer, control console,	7	0:05  0:05	0:05	· <b>-</b> -		0:05	
	calibrate test equipment		Robotics, CCIV, tools/						<del></del>	
			ביובריסים, רפשר פלחילהשפווי							

<b></b>	7874	94/11/11/16	REQUIREMENTS TOOLE	ON OH	FUNC	FUNC CREW SUPPT		MANHOURS	SWAANGO
Install GPS /	Install GPS Antenna Assembly		SS computer, control console, robotics, CCTV, tools/ effectors, test equipment	1	0:45	0:35			REFEREN
Translate robotics to area and secure requi GPS antenna assembly	Translate robotics to storage area and secure required GPS antenna assembly		SS computer, control console, CCTV		0:05				
Translate robotics to processing area	obotics to area		SS computer, control console		0:02			· 	·
Install GPS	Install GPS antenna assembly		SS computer, control console, robotics, CCTV, tools/effectors	8	0:20	0:20 0:20		0:50	
Attach RF cabling as necessary	abling as		SS computer, control console, robotics, CCTV, tools/effectors	~	0:15   0:15	0:15		0:15	
				_			· <b>–</b>		

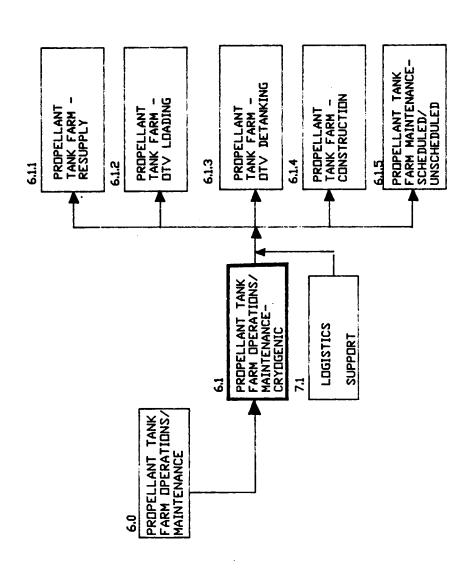
OTV ASSEMBLY PROCESSING - CRYOGENIC

SHEET 8 OF 8

SPOUENCE			REQUIREMENTS		FUNC	CREW SUPPT	L	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG   TIME	TIME	IVA EVA	EVA EVA	TOTAL	REMARKS
5.1.7	Attach Power, Signal and Propellant Umbilicals		SS computer, control console, RMS, CCIV, robotics	   	11:05 0:30	0:30		0:30	
5.1.7.1	Attach power, signal and propellant umbilicals to OTV		SS computer, control console, RMS, CCTV, robotics	- -	0:05				
5.1.7.2	Verify power levels		SS computer, control console	7	0:10				
5.1.7.3	Verify signal transmission		SS computer, control console	-	0:20				
5.1.7.4	Conduct OTV system checks		SS computer, control console		10:00				Correct anomolies - See Section 4.0 maintenance
5.1.7.5	  Verify OTV Safe		SS computer, control console	~	0:30 0:30	0:30		0:30	

## CRYOGENIC PROPELLANT TANK FARM OPERATIONS AND MAINTENANCE

The various aspects of assembling, operating, and maintaining the Cryogenic propellant tank farm at Space Station are identified.



CRYOGENIC

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PROPELLANT TANK FARM OPERATIONS/MAINTENANCE

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

SHEET 1 of 34

	Propellant Tank Farm Operations/Haintenance - Cryogenic  Propellant Tank Farm - Resupply Chill Down LH2 and LO2 Lines Open GH2 and GO2 valves Pressurize lines	REQUITIES Tank farm RMS, CCTV pumps, ment, leal lighting, equipment propellant lines  Control	FACILITIES TOOLS  Tank farm RMS, CCTV, measuring equippups, ment, leak detection lighting, equipment propellant lines  Control console, SS computer  Control console, SS computer	TRNG 2 2 2 2	8:25 2:20 0:05	TWA   EVA     EVA     EVA     EVA     EVA     EVA     EVA     EVA     EVA	HANIIOURS  EVA TOTAL  5:15  0:15	
6.1.1.1.4	Monitor line temperature Install and check out leak detection equipment		Control console, 35 computer, temperature sensors Control console, SS computer	- 8	0:10	0:10	 	required temperature is reached and stabilized  0:10   Correct anomolies

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PROPELLANT TANK PARM OPERATIONS/MAINTENANCE - CRYOGENIC

SHEET 2 of 34

SEQUENCE			REQUIREMENTS		FUNC	CREW	MADE	CREW SUPPT   MANIFOURS	OURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TIME	IVA	EVA	EVA	TOTAL	REMARKS
6.1.1.2	Connect LH2 and LO2 Transfer Lines to Tanker			, 	0:25					
6.1.1.2.1	Verify mechanical/electrical interface between tanker and propellant transfer lines		Control console, SS computer	7	0:20					Correct anomolies
6.1.1.2.1	Verify leak detection equipment operational		Control console, SS computer		0:05					Correct anomolies

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PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

SHEET 3 of 34

SEQUENCE			REQUIREMENTS		FUNC	GEV	UPPT	FUNC   CREW SUPPT   MANHOURS	JRS	
NUMBER	TASK	PACILITIES	TOOLS	TRNG	TRNG   TIME   IVA	VΙ	EVA EVA		TOTAL.	REMARKS
6.1.1.3	Open Tank Farm LH2 and LO2 Propellant Valves				0:15	0:15			0:15	
6.1.1.3.1	Extract GH2 and GO2 boiloff and chill gas to high pressure tanks		Control console, SS computer	~ ~ ~ ~	0:15	0:15			0:15	0:15   Correct anomolies
6.1.1.3.2	Conduct leak detection monitoring		Control console, SS computer, lesk detection equipment		t	1			_ <del></del>	Correct anomolies if leak is detected.

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PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

SEQUENCE			REQUIREMENTS		FUNC	CREW S	FUNC   CREW SUPPT   MANHOURS	MANIE	UKS	
NUMBER	TASK	FACILITIES	T00LS	TRING	TRING TIME	IVA EVA	EVA	EVA	TOTAL	REMARKS
6.1.1.4	Propellant Transfer			<u> </u>	4:10	4:10		'-	4:10	
6.1.1.4.1	Open tanker LH2 & LO2  valves		Tanker control	7	0:05	0:05			0:05	
6.1.1.4.2	Monitor propellant transfer		Control console, SS computer, flow meters	7	4:00	00:-			4:00	
6.1.1.4.3	Conduct leak detection monitoring		Control console, SS computer, leak detection equipment	-					-   Correct	Correct anomolies if leak is detected
6.1.1.4.4	Close tanker LH2 & LO2  valves when transfer complete		Control console, SS computer, flow meters, tanker controls	~	0:05	0:02			50:0	

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PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

	S						
	REMARKS					Correct anomolies	
MANHOURS	TOTAL	0:30	0:15	0:05	0:10		
L	EVA						
CREW SUPPT	EVA						
CREW	IVA	0:3	0:15	0:05	0::0		
FUNC	TIME	8	0:15	0:05	0:10	0:10	0:20
	TRNG		~	8	~		
REQUIREMENTS	TOOLS		Control console, SS computer, flow meters	Control console, SS computer	Control console, SS computer	Control console, SS computer	Control console, SS computer
	FACILITIES						
	TASK	Complete Transfer	Blow back LH2 and LO2 lines - tanker to Tank Parm	Blow back complete - close tank farm LH2 and LO2 valves	Evacuate excess GH2 and GO2 from propellant lines to high pressure storage	Verify Propellant Tank Farm VCS system operational	Disconnect LH2 and LO2 propellant lines from tanker
SEQUENCE	NUMBER	6.1.1.5	6.1.1.5.1	6.1.1.5.2	6.1.1.5.3	6.1.1.5.4	6.1.1.5.5

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

SHEET 6 of 34

SEQUENCE			REQUIREMENTS		FUNC	FUNC CREW SUPPT   MANIBURS	UPPT	MANIE	DURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TIME	IVA	EVA	EVA	TOTAL	REMARKS
6.1.1.6	Secure Tanker from Propellant Transfer Operations - TBD			<u> </u>	· ·			<b></b>	<u>-</u>	
6.1.1.7	Place Tank Farm in Standby Mode - Continue leak		Control consolé, SS computer		0:15	50:02		<u>-</u> -	0:05	
6.1.1.8	Secure Space Station from propellant transfer operations - TBD		Control console, SS computer		1					

PROPELLANT TANK PARM OPFRATIONS/MAINTENANCE - CRYOGENIC

SHEET 7 of 34

PEMAPKS	N. L.			Correct Anomolies		0:30   Continue recycling until required temperature is reached and stabilized.	Correct Anomolles
MANHOURS	9:55		0:40	Corre		0:30  Conti	0:10   Corre
	4						
CREW SUPPT	<b>8</b>						
CREW	9:55		0:40			0:30	0:10
FUNC	9:55		2:20	0:05	50:01	7:00	0:10
SN QH	-			~	7		
REQUIREM	Tank farm, Control console, SS computer,	SS hangar, CCTV, leak detection equip- 11ghting, ment, flow meters power signal, propellant	Control console, SS computer	Control console, SS computer	Control console, SS computer	Control console, SS computer, temperature sensors	Control console, SS computer
24/41/11/44	Tank farm,	SS hangar, 11ghting, 1 power signal, propellant umbilicals					· 
TASK	Propellant Tank	Parm - OTV Loading	Chill Down LH2 AND LO2 Lines and Umbilicals	Open GH2 and GO2 valves	Pressurize lines	Monitor line and umbilical  temperature	Install and checkout leak detection equipment
SEQUENCE	6.1.2		6.1.2.1	6.1.2.1.1	6.1.2.1.2	6.1.2.1.3	6.1.2.1.4

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PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOCENIC

SPOIIFNCE			REOUIREMENTS		FUNC	CREW SUPPT	ĺ	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TIME	IVA EVA	EVA	TOTAL	REMARKS
6.1.2.2	Chill Down OTV LH2 and LO2 Propellant Tanks				1:50	0:10		0:10	
6.1.2.2.1	Connect LH2 and LO2		Control console, SS computer		0:20				Correct Anomolies
6.1.2.2.2	Pressurize LH2 and LO2 tanks with CH2 and GO2		Control console, SS computer	8	0:05			. <b></b> .	Correct Anomolies
6.1.2.2.3	Monitor tank temperature		Control console, SS computer, temperature sensors	-	1:00	0:05		0:02	0:05   Continue recycling, until   required temperature is   reached and stabilized.
6.1.2.2.4	  Depressurize LH2 and  LO2 tanks		Control consol SS computer	7	0:20	0:05		0:05	
6.1.2.2.5	Close OTV LH2 and LO2		Control console, SS computer	~	0.05				

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PROPELLANT TANK FARM OPERATIONS/WAINTENANCE - CRYOGENIC

	REMARKS			0:05   Correct anomolies	Correct anomolies	4:00   Correct anomolies
MANHOURS	TOTAL.	4:10	0:02	0:02		4:00
<u>.                                    </u>	EVA					
FUNC   CREW SUPPT	EVA					
CRE	IVA	4:10	10:05	0:02		4:00
FUNC	TRNG TIME	4:10	0:02	50:02		4:00
	TRING			7		~
REQUIREMENTS	TOOLS		Control console, SS computer	Control console, SS computer	Control console, SS computer, leak detection equipment	Control console, SS computer, leak detection equipment
	FACILITIES					
	TASK	Main Propellant Transfer	Open tank farm LH2 and LO2 valve	Extract GH2 and GO2 boiloff and chill down gas to high pressure tanks	Conduct leak detection  Monitoring	Open OTV LH2 and LO2  valves - commence propellant  transfer
SEDITENCE	NIMBER	6.1.2.3	6.1.2.3.1	6.1.2.3.2	6.1.2.3.3	6.1.2.3.4

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

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SPOHENCE			REQUIREMENTS		FUNC	CREW SUPPT	UPPT	MANIIOURS	OURS	
NUMBER	TASK	FACILITIES	T00LS	TRNC	TRNG   TIME	IVA		EVA	TOTAL	REMARKS
6.1.2.4	  Main Propellant Transfer				0:05	0:05			0:05	
	Complete									
6.1.2.4.1	Close OTV LH2 and LO2		Control console, SS computer	7	0:05	0:05			0:05	
	l valves		<del>-</del>	-		_	_	_	-	

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOCENIC

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SEOUENCE			o Enghantioa a				1	NA SULPHIOLOGY	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TIRE	IVA EVA		EVA TOTAL	REMARKS
6.1.2.5	Prepare GH2, GO2 and GH2 RCS Propellant Spheres				0:30	0:05		0:02	
6.1.2.5.1	Open OTV GH2, GO2 and GHe RCS valves		Control console, SS computer	- 2 -	0:05				
6.1.2.5.2	Pressurize GH2, GO2 and GHe spheres		Control console, SS computer	- 2	0: 20	0:05		0:02	0:05   Pressurize to required   level.
6.1.2.5.3	Conduct leak detection monitoring	· .	Control console, SS computer, leak detection equipment						Correct anomolies
6.1.2.5.4	Close OTV GH2, GO2 and GHe RCS valves		Control console, SS computer	7	10:05				Correct anomolies
	-	-		_	_	-	-	_	_

PROPELLANT TANK FARM OPERATIONS/HAINTENANCE - CRYOGENIC

SHEET 12 of 34

SEQUENCE			REQUIREMENTS		FUNC	CKEW	UPPT	CREW SUPPT   MANHOURS	URS	
NUMBER	TASK	FACILITIES	TOOLS	TRING	TRNG   TIME	IVA IEVA		EVA T	TOTAL	REMARKS
6.1.2.6	OTV Main and RCS Propellant Transfer Complete				0:45	0:25			0:25	
6.1.2.6.1	Disconnect propellant		Control console, SS computer	<del></del> -	0:20					
6.1.2.6.2	  Verify OTV safed		Control console, SS computer		0:05	0:05			0:05       	  Correct anomolies
6.1.2.6.3	Blowdown LH2 and LO2 lines and umbilicals		Control console, SS computer	<del>-</del> -	0:15	0:15			0:15   Ac	Accomplianed after OMV/OTV/ Payload stack is deployed from space atarion
6.1.2.6.4	Close Propellant Tank Farm		Control console, SS computer	- <del>-</del>	0:02	0:03			0:02	

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PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

SHEET 13 of 34

EQUENCE			REQUIRENENTS		FUNC	CKEV	SUPPT	FUNC CREW SUPPT   MANHOURS	URS	
NUMBER	TASK	FACILITIES	TOOLS	TRMG	TRNG   TIME   IVA   EVA   EVA   TOTAL	IVA	EVA	EVA 17	OTAL.	REMARKS
6.1.2.7	Tank Farm Placed in Standby		Control console, SS computer 1+2 0:15	: 11+2		0:15		<b></b> '-	0:15	0:15 Accomplished after OMV/OTV/
										raytoan at are reprofes
6.1.2.8	Space Station Secured From	_	Control console, SS computer   1+2	: 1+2			_	_	_	
	Propellant Transfer	_		_	_		_	_		
	Operations - TBD	- -		_	_	_	_	_	_	

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PROPELIANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

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SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	Ļ	MANIFOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	IVA EVA	EVA	TOTAL	REMARKS
6.1.3	Propellant Tank Farm - OTV Detanking			   	5:10	5:10		5:10	
6.1.3.1	Chill Down LH2 and LO2 Lines and Umbilicals		Control console, SS computer	 	2:35	0:15		0:15	Complete only if steps 6.1.2.6.3 and 6.1.2.6.4 were not completed.
6.1.3.1.1	Open GH2 and GO2 valves		Control console, SS computer	~	0:05				
6.1.3.1.2	Pressurize lines		Control console, SS computer, temperature sensors	~	0:05				Continue recycling until required temperature is reached or stabilized.
6.1.3.1.3	Monitor line and umbilical		Control console, SS computer,	7	2:00				
6.1.3.1.4	Install and check out leak detection equipment		Control console, SS computer, robotics	~ ~	0:10	0:10		0:10	
6.1.3.1.5	Open LH2 and LO2 tank farm valves		Control console, SS computer	~ _	50:02				
6.1.3.1.6	Extract GH2 and GO2 from lines and umbilicals		Control console, SS computer	~	0:02	0:02		0:05	
6.1.3.1.7	Close GH2 and GO2 Valves		Control console, SS computer		0:02				

PROPELIANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

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SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	JPPT	MANHOURS	OURS	
NUMBER	TASK	FACILITIES	T001,S	TRNG	TIME	IVA EVA		EVA	TOTAL	REMARKS
6.1.3.2	OTV Detanking			7	1:45	1:00		<u>-</u>	1:00	
6.1.3.2.1	Connect umbilicals to 0TV		Control console, SS computer	7	0:20					
6.1.3.2.2	Verify electrical/mechanical connections		Control console, SS computer	-	0:20					
6.1.3.2.3	Pressurize OTV LH2 and LO2 Tanks		Control console, SS computer		10:05				<u> </u>	Accomplished through use of RCS GH2 and GO2 residual gas.
6.1.3.2.4	Open OTV LH2 LO2 valves		Control console, SS computer	7	1:00	1:00			1:00	
6.1.3.2.5	Leak detection monitoring								<u> </u>	Correct anomolies

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

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	<b>LRKS</b>		e e s		les	les
	REMARKS		Correct anomolies		Correct anomolies	0:05   Correct anomolies
MANHOURS	TOTAL.	0:20		0:15		0:05
_	EVA					
CKEW SUPPT	EVA					
CREW	IVA	0:20		0:15		0:05
FUNC	TIME	0:30	0:02	0:15	0:02	0:05
	TRNC	1	2	~	8	7
REQUIREMENTS	TOOLS		Control console, SS computer	Control console, SS computer	Control console, SS computer	Control console, SS computer
	FACILITIES					
	TASK	OTV Detanking Complete	Close OTV LH2 and LO2	Blowback LH <sub>2</sub> and LO <sub>2</sub> lines and umbilicals	Close tank farm LH2 and LO2 valves	Evacuate GH2 and GO2 from LH2 and LO2 lines
SEQUENCE	NUMBER	6.1.3.3	6.1.3.3.1	6.1.3.3.2	6.1.3.3.3	6.1.3.3.4

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

SHEET 17 of 34

SEQUENCE			REQUIREMENTS		FUNC	FUNC   CREW SUPPT   MANHOURS	SUPPT	MAN	OURS	
NUMBER	TASK	PACILITIES	TOOLS	TEME	TIME	_	EVA	IVA   EVA   EVA   TOTAL	TOTAL	REMARKS
6.1.3.4	Place Tank Farm in Standby Mode		Control console, SS computer   1+2		0:15	0:15			0:15	
6.1.3.5	Secure Space Station from OTV Detanking Operations - IBD		Control console, SS computer	1						

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

SHEET 18 of 34

SEQUENCE NUMBER	TASK	FACILITIES	REQUIREMENTS TOOLS	TRNC	FUNC	CREW SUPPT IVA EVA		MANHOURS EVA   TOTA	IOURS   REMARKS	
6.1.4	Tank Farm Construction	SS hangar, HRMS, 118hting, power,	SS computer, control console, CCTV, robotics, tools/effectors, test equipment, leak detection equipment, software	1	34:05	34:05	7:20 1	7:20 14:40 29:15	:15  Switch EVA and total times	88
6.1.4.1	Install Propellant Transfer Lines				8:50	8:50	4:40	9:20	17:55	
6.1.4.1.1	Translate MRMS to shuttle docking area		SS computer, control console	- <del>-</del>	0:15	0:15			0:15	
6.1.4.1.2	Translate MRMS to hangar with LO2 control valve and manifold		SS computer, control console		0:20	0:20			0:20   18' section	
6.1.4.1.3	Attach LO2 control valve and manifold to outer structure		SS computer, tools, CCTV	<u> </u>	0:20	0:20	0:20	0:40	1:00	
6.1.4.1.4	Translate MRMS to shuttle docking area		SS computer, control console		0:15	0:15		- <u>-</u> -	0:15	
6.1.4.1.5	Translate MRNS to hangar with LH2 control valve and manifold		SS computer, control console	_ <del></del>	0:20	0:20	<u>-</u>		0:20	
6.1.4.1.6	Attach LH2 control valve and manifold to out structure		SS computer, tools, CCTV	_ 	0:20	0:20	0:20 0:40		1:00   10' section	
6.1.4.7	Translate MRMS to shuttle docking area		SS computer, control console		1:00	1:00			1:00  Secure remaining 3 sections  each 54' - 20 min/section	lons
6.1.4.1.8	Translate MRMS to install- ation site	-	SS computer, control console	~	1:00	1:00			1:00	
6.1.4.1.9	Attach 3 sections to outer structure		SS computer, tools, CCTV	<u></u>	1:00	1:00	1:00	5:00	3:00	
6.1.4.1.10	Secure remaining LH2 sections and translate to installation site		SS computer, control console	~	1:00	1:00			1:00 Remaining 3 sections each   54°. Section 3 contains   shuttle LH2 control valve.	4
6.1.4.1.11	Attach 3 sections to outer structure		SS computer, tools, GCTV	- <del></del> -	1:00	1:00	1:00  2	8	3:00	
6.1.4.1.12	Secure and attach LO2 boom to LO2 line		SS computer, tools, CCTV	- <del></del>	11:00	1:00		00: 		
6.1.4.1.13	Secure and attach LH2 boom to LH2 line		SS computer, tools CCTV	<u> </u>	11:00	1:00	1:00	2:00  3	3:00	
	-	-	A-115		_	_	-	-		

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

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	REMARKS				Self test
		 ଆ	<del></del> -		Self
FUNC CREW SUPPT   MANHOURS	EVA   TOTAL	1:20	0:50	- <del>-</del>	
Ä.	EVA				
A SUPP	IVA EVA	_ ଲା	- <del>-</del> -	- <del>_</del>	
CRE	IVA	1:20	0:20	1:00	
FUNC	TRNG   TIME	7:50	0:20	1:00	- <del>[6</del> :30
	TRNG	1	~	~	
REQUIREMENTS	TOOLS		SS computer, control console	SS computer, control console tools	SS computer, software, control 2 console
	PACILITIES				
	TASK	Propellant Control Console	Translate propellant control console through space station airlock	Install and secure propellant control console	Conduct system test of propellant control console
SEQUENCE	NUMBER	6.1.4.2	6.1.4.2.1	6.1.4.2.2	6.1.4.2.3

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PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

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SEQUENCE NUMBER 6.1.4.3	TASK Install Propellant Module	FACILITIES	REQUIREMENTS TOOLS	TRING	FUNC TIME 8:50	CREW SUPPT IVA   EVA		EVA TOTAL 2:40 5:00	TOTAL S:00	REMARKS
	No. 1 Translate MRMS to shuttle docking area		SS computer, control console	~~~	0:15	0:15			0:15	
	Translate MRMS to propellant module No. 1 attaching point		SS computer, control console tools		0:45	0:45			0:45	0:45 Approximately 5,000 1bm
<del></del>	Attach propellant module to attachning points		SS computer, tools	<u>~</u>	0:20	0:20	0:20 0:20	0:40	1:00	
	Connect propellant module to LO2 and LH2 manifolds		SS computer, tools	<u> </u>	1:00	1:00	1:00	2:00	3:00	
	Pressurize system and conduct pressure and system test		SS computer, gauges, leak detection equipment	~	6:30			<del></del>		

## PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

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	TASK   FACILITIES TOOLS   TRNC   TIME   IVA   EVA   TOTAL   REMARKS	pellant module   See 6.1.4.3 above for tool   2+3   8:50   2:20   1:20   5:00   See 6.1.4.3   tool requirements
RE	FACII	Install propellant module
SEQUENCE	NUMBER	6.1.4.4   In

PROPELIANT TANK FARM OPERATIONS/MAINTENANCE - CRYOCENIC

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CREW SUPPT   MANHOURS	IVA EVA EVA TOTAL REMARKS		6:00   6:00   Conducted periodically on modules and propellant transfer lines	Continuious when tank farm is in standby mode, transfer operations and detanking	3:00   3:00   Conducted periodically on all major components 1.e.
FUNC	TIME		00:9		3:00
	TRNG		8	8	8
REQUIREMENTS		Control console, SS computer test equipment, CCTV	SS computer, control console,  CCTV	SS computer, control console, halographic equipment, pressure gauges, leak detection equipment	SS computer, control console pressure drop gauges, test equipment
	FACTLITIES	Space station power, lighting			
	TASK	Propellant Tank Farm Scheduled Maintenance	Visual Inspection	Leak Check	Diagnostic Testing
SEOUENCE	NUMBER	6.1.5	6.1.5.1	6.1.5.2	6.4.5.3

PROPELLANT TANK PARM OPERATIONS/MAINTENANCE - CRYOGENIC

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	TASK	FACILITIES	REQUIREMENTS TOOLS	TRNG	FUNC	CREW SUPPT	- E	3//	TOTAL REMARKS
agch Bach	Propellant Tank Farm Unscheduled Maintenance	space station power lighting MRMS, RMS	Control console, SS computer   trobotocs. CCTV, tools,   effectors, test equipment						
2 ng	Repair Propellant Module Insulation				2:05	0:55		öl 	0:55
ran rea :fe	Translate robotics to tool area-secure and stow tools/		Control console, SS computer, robotics, tools/effectors, CCTV	<del>-</del>	0:0	0:05			0:05
180 180 180	Translate robotics to parts area-accure and stow insulation repair kit		Control console, SS computer, robotics, tools/effectors, CCTV		0:0				
in in its	Translate robotics to SS hangar porch - transfer repair kit, tools/effectors to external robotics		Control console, SS computer, robotics, tools/effectors, CCTV	<u></u>	0:15				·
ē .	Translate external robotics to work site		Control console, SS computer,		0:15				
原었	Remove Damaged Insulation section-stow	<b>ــــــــــــــــــــــــــــــــــــ</b>	Control console, SS computer, CCTV, tools/effectors robotics	7	0:30	0:30		ö .––-	0:30
<b>2</b> 2	Install new insulation section-verify seal		Control console, SS computer, CCTV, tools/effectors robotics	- <del></del>	0:20	0:20			0:20
전보	Translate robotics to hangar porch-transfer repair kit		Control console, SS computer CCTV, tools/effectors, robotics		0:15				
<b>8</b> 9	Translate robotics to parts area-stow repair kit		Control console, SS computer, CCTV		0:02	0:02		ö 	0:05 Package demaged insulation
Ď	Secure external robotic		Control console, SS computer	<del>-</del> -	0:02				
ē ē	Translate robotics to tool area-secure tools/effectors		Control console, SS computer,		0:02				
ភ្ល	Secure robotics		Control console, SS computer		0:02				
			A-120				MA	RTI	RTIN MARIETTA

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

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TASK	PACILITIES	TOOLS	TRNC	TIME	IVA EVA	EVA   TOTAL	REMARKS
Motor/Compressor Unit Replacement (Low Pressure)	space station power, 11ghting,	Control console, SS computer, CCIV, tools/effectors, robotics, test equipment		4:40	3:30	 3:30	LH2 or LO2 units within propellant transfer unit.
Translate robotics to tool area secure and stow tools and effectors		Control console, SS computer,		0:05		 	
Translate robotics to parts area-secure replacement motor/compressor unit		Control console, SS computer, CCTV, tools/effectors		0:05		 	
Translate robotics to hangar porch-transfer tools/ effectors to external robotics		Control console, SS computer, CCTV, tools/effectors		0:15		 	
Translate external robotic to work site-open and secure access panel		Control console, SS computer, CCIV, tools/effectors	~~~~	0:15	0:15	 0:15	
Disconnect and remove motor/		Control console, SS computer, CCTV, tools/effectors	~ ~ ~	1:00	1:00	 1:00	
Translate external robotic to hangar porch w/motor compressor unit		Control console, SS computer, CCIV	~	0:15	0:15	 0:15	- <u></u>
Secure replacement motor/ compressor unit-translate to work site		Control console, SS computer, CCIV	~	0:15	0:15	 0:15	
Install replacement motor compressor to work site		Control console, SS computer, CCTV, robotics, tools/ effectors	~	1:00	1:00	 1:00	
Pressurize system - conduct leak check/functional test		Control console, SS conputer, CCIV, test equipment, leak detection equipment	~	0:30		 <b>-</b>	
Secure access panel- translate external robotic			~	0:15	0:15	 0:15	
Transfer tools/effectors to internal robotics-translate internal robotics to part area w/motor/compressor unit		Control console, SS computer, CCTV, robotics	~ ~~	0:15	0:15	 0:15	0:15

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PROPELLANT TANK FARM OPFRATIONS/MAINTENANCE - CRYOGENIC

SEQUENCE			REQUIREMENTS		FUNC   CREW SUPPE	CREW S	UPPF	MANHOURS	URS	
NUMBER	TASK	FACILITIES	TOOLS	TRING	TIME	IVA	EVA	EVA 1	TOTAL	REMARKS
6.1.6.2.12	Secure external robotic				0:05					
6.1.6.2.13	Package unserviceable motor/ compressor unit		Control console, SS computer, ICCTV, robotics, tools/effectors		0:15	0:15			0:15	0:15 Return to earth
6.1.6.2.14	Translate robotics to tool area-secure tools/effectors		Control console, SS computer,  CCTV		0:05					
6.1.6.2.15	Secure robotics	<b>. –</b> –	Control console, SS computer		0:05					

PROPELLANT TANK FARH OPERATIONS/HAINTENANCE - CRYOGENIC

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	REMARKS	Less motor compressor unit LH2 or LO2				<u> </u>					ARTIN MARIETTA
MINOTINE	A TOTAL	4:15			<del></del>	0:15	0:15	1:00	1:00	0:15	0:15
-	- =									- <del></del> -	W
addilo nado	IVA   EVA	4:15				0:15	0:15	1:00	1:00:	0:15	0:15
Γ	TIME II	5:15	0:05	0:15	0:15	0:15	0:15	00:1	1:00	0:15	0:15   0
-	TRNG 17		·		~	~	~~~~		~	~	~
STWENSOTTONG	TOOLS	Control console, SS computer, CCIV, tools/effectors, robotics, test equipment	Control console, SS computer, CCTV	Control console, SS computer, CCTV	Control console, SS computer,	Control console, SS computer, CCTV, tools/effectors	Control console, SS computer, CCTV	Control console, SS computer, CCTV, tools/effectors, robotics	Control console, SS computer, CCTV, tools/effectors, robotics	Control console, SS computer, CCTV	Control console, SS computer CCTV A-123
	PACILITIES	space station power, lighting, MRMS									
	TASK	Propellant Transfer unit Replacement	Translate robotics to tool area-secure and stow tools/effectors	Translate robotics to hangar proch-transfer tools/ effectors to external robotics	Translate RMS to parts area- secure and translate propellant transfer unit to hangar porch	Translate external robotics to propellant module-open access panel	Translate MRMS to hangar porch-secure propellant transfer unit-translate to work site	Disconnect and remove propellant transfer unit	Secure serviceable propellant transfer unit from MRMS and install	Secure unserviceable propellant transfer unit w/RMS-translate to hangar porch	Secure unserviceable propellant transfer unit W/RMS translate to parts area
SEQUENCE	NUMBER	6.1.6.3	6.1.6.3.1	6.1.6.3.2	6.1.6.3.3	6.1.6.3.4	6.1.6.3.5	6.1.6.3.6	6.16.3.7	6.1.6.3.8	6.1.6.3.9

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PROPELIANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

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SEOUENCE			REOUIREMENTS		FUNC	CREW SUPPT	MANI	MANHOURS	
NUMBER	TASK	FACILITIES	S	TRNG		IVA EVA	EVA	TOTAL.	REMARKS
6.1.6.3.10	Secure MRMS and RMS		Control console, SS computer		0:10				
6.1.6.3.11	Ptesaurize System-conduct leak check.		Control console, SS computer, CCTV, leak detection equipment	٥.	0:30	0:30		0:30	
6.1.6.3.12	Secure access panel-translate external robotics to hangar porch		Control console, SS computer, CCTV	8	0:15	0:15		0:15	
6.1.6.3.13	Transfer tools/effectors to internal robotics-translate to parts area		Control console, SS computer, CCTV		0:15	0:15		0:15	
6.1.6.3.14	Secure external robotics		Control console, SS computer		0:05				
6.1.6.3.15	Package propellant transfer unit for shipment		Control console, SS computer, CCTV, tools/effectors	-	0:15	0:15		0:15   Re	0:15 Return to earth
6.1.6.3.16	Translate robotics to tool area-secure tools/effectors		Control console, SS computer, CCTV		0:05				
6.1.6.3.17	Secure robotics		Control console, ŚS computer		0:05				

PROPELLANT TANK PARM OPERATIONS/MAINTENANCE - CRYOGENIC

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achanoas			REGITTREMENTS		FUNC	CREW SUPPT	JPPT	MANHOL	JRS	
NUMBER	TASK	FACILITIES		TRNC	$\sqcap$	IVA	1 1	EVA TOTAL	OTAL	REMARKS
6.1.6.4	Remove and Replace Motor/ Compressor (High Pressure)	space station power, lighting,	Control console, SS computer, CCIV, tools/effectors, robotics, test equipment		4:10	2:50		```! ~~~~~~	2:50	Hydrogen storage accumulators
6.1.6.4.1	Translate robotics to tool area-secure and stow tools/effectors		Control console, SS computer,		0:05					
6.1.6.4.2	Translate robotics to parts area-secure ans stow replacement motor/compressor		Control console, SS computer,		0:02					
6.1.6.4.3	Translate robotics to hangar proch-transfer tools/ effectors and motor/ compressor to external robotics		Control console, SS computer,		0:15					
6.1.6.4.4	Translate external robotics to propellant module-open access door		Control console, SS computer CCTV, tools/effectors, robotics		0:15	0:15			0:15	
6.1.6.4.5	Verify high pressure is bled off		Control console, SS computer, CCTV, tools/effectors, robotics	~	0:05	0:05			0:05	
6.1.6.4.6	Disconnect, remove, and stow unserviceable motor/		Control console, SS computer  CCTV, tools/effectors,  robotics	~	1:00	1:00			1:00	
6.1.6.4.7	Install and connect service- able motor/compressor		Control console, SS computer, CCTV, tools/effectprs, robotics		1:00	1:00			1:00	
6.1.6.4.8	Pressurize system-conduct  leak and functional test		Control console, SS computer CCTV, leak detection eqipment, pressure gauges.	~	0:30					
6.1.6.4.9	Secure access panel-translate external robotics to hangar porch		Control console, SS computer,		0:15	0:15			0:15	
6.1.6.4.10	Transfer motor compressor, tools/effectors to internal robotics-translate to pants		Control console, SS computer, CCTV A-125	, 5	0:15			187	7112	
	larea	_	)   T   T   T   T   T   T   T   T   T	-	-	-				

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PROPELIANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

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SEOUENCE			REOUTREMENTS		FUNC   CREW SUPPT	CREW S	UPPT	MANHOURS	JURS	
NUMBER	TASK	FACILITIES	L	TRNG	TRNG TIME IVA EVA EVA	IVA	EVA		TOTAL	REMARKS
6.1.6.4.11	Package unserviceable motor/ compressor		Control console, SS computer CCTV, tools/effectors		0:15	0:15			0:15	0:15 Return to earth
6.1.6.4.12	Translate robotics to tool area-secure tools/effectors		Control console, SS computer CCTV		0:05					
6.1.6.4.13	Secure robotics		Control console, SS computer		0:02					

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOCENIC

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aonaireas					Γ		-	a qui contra ve		
NUMBER	TASK	PACITITIES	REQUIREMENTS TOOLS	TOMO	FUNC	CREW SU	SUPPI I M	MANHOURS	T T T T T T T T T T T T T T T T T T T	
6.1.6.5	ator Tor	Space station power, lighting,	Control conso CCTV, tools/e robotics, tes			35				1
6.1.6.5.1	Translate robotics to tool area-secure and stow tools/ effectors		Control console, SS computer,		0:02					
6.1.6.5.2	Translate robotics to hangar porch-transfer tools/ effectors to external robotics		Control console, SS computer, CCTV		0:15					•
6.1.6.5.3	Translate RMS to parts areassecure hydrogen accumulator- translate to hangar porch		Control console, SS computer,	<b></b> -	0:15					
6.1.6.5.4	Translate robotics to propellant module-open access panel		Control console, SS computer,  CCTV, tools/effectors		0:15	0:15		0:15		
6.1.6.5.5	Transfer hydrogen accumulator to MRMS-translate MRMS to work site		Control console, SS computer,	~	0:15	0:15		0:15		
6.1.6.5.6	Verify high pressure is bled off		Control console, SS computer, pressure gauges	- <del></del>	0:05	0:05		0:02		
6.1.6.5.7	Disconnect and remove hydrogen accumulator		Control console, SS computer, CCTV, tools/effectors	7	1:00	1:00		1:00		
6.1.6.5.8	Secure replacement hydrogen accumulator from MRMS and install		Control console, SS computer,	8	1:00	1:00		1:00		
6.1.6.5.9	Secure unserviceable hydrogen accumulator W/MRMS - translate to hangar porch		Control console, SS computer,		0:15	0:15		0:15		
6.1.6.5.10	Transfer hydrogen accumulator to RMS-translate		Control console, SS computer,	7	0:15	0:15		0:15		
	RMS to parts area		A-127				MA	RTIA	MARTIN MARIETTA	

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PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYGGENIC

SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	SUPPT	MANHOURS	URS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC TIME	TIME	ΙΛΥ	EVA	EVA	TOTAL	REMARKS
6.1.6.5.11	Secure MRMS and RMS		Control console, SS computer		0:02					
6.1.6.5.12	Pressurize hydrogen accumulator-conduct leak check		Control console, SS computer, CCTV, leak detection equipment, pressure gauges	8	0:30					
6.1.6.5.13	Secure access panel and translate external robotics to hangar porch		Control console, SS computer, CCTV, tools/effectors	8	0:15	0:15			0:15	
6.1.6.5.14	Transfer tools/effectors to internal robotics-translate to parts area		Control console, SS computer CCTV	~	0:15		<u>-</u>			
6.1.6.5.15	Package, unserviceable   hydrogen accumulator		Control console, SS computer, GCTV		0:15	0:15			0:15	
6.1.6.5.16	Translate robotics to tool area-secure tools/effectors		Control console, SS computer		0:05					
6.1.6.5.17	Secure Internal/external robotics		Control console, SS computer	<del>-</del>	0:02					
	_	•								

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

SEOMENCE			RECHIREMENTS		FUNC	CREWS	Suppr	MANHOURS	JRS	
NUMBER	TASK	FACILITIES	S	TRNC	TIME	IVA		EVA T		REMARKS
6.1.6.6	Remove and Replace Hydrogen Accumulator Valve Module	space station power, lighting,	Control console, SS computer, CCTV, tools/effectors, robotics, test equipment		3:45	2:25			2:25	
6.1.6.6.1	Translate robotics to tool area-secure and stow tools/ effectors		Control console, SS computer, CCTV	-	0:05					
6.1.6.6.2	Translate robotics to parts area-secure and stow valve module		Control console, SS cosputer, CCTV		0:05					
6.1.6.6.3	Translate robotics to hangar porch-transfer tools/effectors valve module to external robotics		Control console, SS computer,	-	0:15		<del></del>			
6.1.6.6.4	Translate robotics to work site-open access panel		Control console, SS computer, CCTV, tools/effectors	~	0:15	0:15			0:15	
6.1.6.6.5	Verify pressure is bled from		Control console, SS computer, pressure gauges	7	0:02	0:02			0:05  High pressure	ıre
6.1.6.6.6	Remove unserviceable valve system & stow		Control console, SS computer, CCTV, tools/effectors, robotics	~	0:45	0:45			0:45	
6.1.6.6.7	Install serviceable valve		Control console, SS computer, CCIV, tools/effectors	8	0:45	0:45	- <b>-</b>		0:45	
6.1.6.6.8	Pressurize system-conduct leak check		Control console, SS computer, leak detection equipment, CCTV	8	0:30					
6.1.6.6.9	Close access panel-translate robotics to hangar porch		Control console, SS computer, CCTV	8	0:15	0:15			0:15	
6.1.6.6.10	Transfer unservicable valve module, tools/effectors to internal robotics-translate to parts area		Control console, SS computer, CCTV	8	0:15					
6.1.6.6.11	Package unserviceable valve module		Control console, SS computer, CCTV, tools/effectors		0:20	0:50			0:20 Return to earth	arth
6.1.6.6.12	Translate robotics to to area-secure tools/effectors		Control cosole, SS computer		0:05		- MA	A A A	RTIN MARI	ETTA
6.1.6.6.13	Secure robotics		Control console, SS computer		0:05					
٠	-	-	. 120		_	-	•	•	•	

PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYCCENIC

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achaileac			PENEMENT		FIINC	CREW SIPPT	-	MANHOURS	
NUMBER	TASK	FACILITIES	S	TRING	$\perp$	IVA EVA	<u></u>	TOTAL	REMARKS
6.1.6.7	Remove and Replace Propellant Line	Space atation power, lighting,	Control console, SS computer, CCIV, tools/effectors, robotics, test equipment		5:45	4:10		4:10	
6.1.6.7.1	Translate robotics to tool area-secure and stow tools/effectors, test equipment		Control console, SS computer CCTV		0:05		<u>-</u> -		
6.1.6.7.2	Translate robotics to parts area-secure and stow propellant line repair kits		Control console, SS computer	-	0:05			105:	
6.1.6.7.3	Translate hangar RMs to parts area-secure serviceable propellant line sections		Control console, SS computer	-	0:02				
6.1.6.7.4	Translate robotics & RMS to hangar prorch		Control console, SS computer CCTV	1+2	0:15	0:15		0:15	
6.1.6.7.5	Transfer tools/effectors, repair units to external robotics		Control console, SS computer CCTV	<u></u>	0:10				
6.1.6.7.6	Transfer serviceable propellant line to MRMS		Control console, SS computer CCTV	~	0:02	0:02		0:02	
6.1.6.7.7	Translate robotics to work site		Control console, SS computer  CCTV	8	0:15				Assumed max distance from hangar
6.1.6.7.8	Release first propellant line connection/joint		Control console, SS computer (CCTV, tool/effectors	2	0:20	0:20		0:20	
6.1.6.7.9	Translate robotics to second connection/joint and release		Control console, SS computer CCTV, tool/effectors		0:25	0:25		0:25	
6.1.6.7.10	Release propellant line retaining straps and remove propellant line		Control console, SS computer CCTV, tool/effectors	2	0:20	0:20	MAN	0:20	MARIETTA
6.1.6.7.11	Translate MRMS to work site		Control console, SS computer tool/effectors	7	0:15	0:15		0:15	
6.1.6.7.12	Exchange propellant lines		Control console, SS computer CCTV	2	0:10	0:10		0:10	
6.1.6.7.13	Translate MRMS to hangar  porch - transfer  unserviceable propellant  line to hanger RMS		Control console, SS computer CCTV A-130	2	0:15	0:15		0:15	

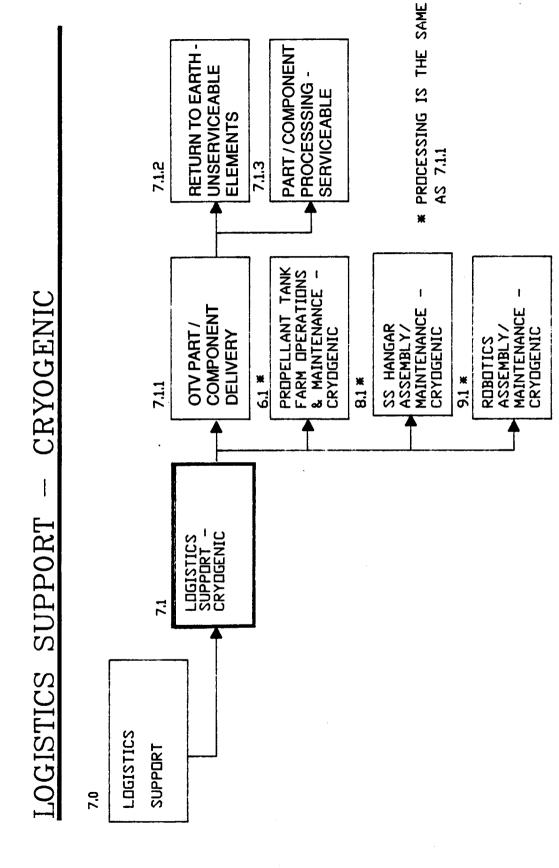
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PROPELLANT TANK FARM OPERATIONS/MAINTENANCE - CRYOGENIC

SEQUENCE			REQUIREMENTS		П	is.		I	l L
NUMBER	TASK	FACILITIES	LOOLS	TRNC	TIME	IVA	EVA EVA	TOTAL	AL REMARKS
6.1.6.7.14	Install serviceable propellant line - secure first connection/joint		Control console, SS computer CCTV, tool/effectors, repair kit	~ ~ ~ ~ ~	0:30	0:30			0:30
6.1.6.7.15	Translate RMS to parts area		Control console, SS computer CCIV	~	0:20	0:20			0:20
6.1.6.7.16	Translate robotics to second connection/joint and secure		Control console, SS computer CCTV, tools/effectors, repair kit	~	0:35	0:35		 	0:35
6.1.6.7.17	Secure propellant line retaining strips		Control console, SS computer CCTV, tools/effectors,	~	0:20	0:20		<u> </u>	0:20
6.1.6.7.18	Pressurization line - Conduct leak check		Control console, SS computer CCIV, pressure gauges	2	0:30				
6.1.6.7.19	Translate robotics to hangar porch; transfer tools/effectors and repair kit to interval robotics		Control console, SS computer CCTV		0:10				
6.1.6.7.20	Translate robotics to parts area		Control console, SS computer CCTV		0:15				
6.1.6.7.21	Prepare propellant line and repair kit for shipment		Control console, SS computer CCTV, tolls/effectors		0:20	0:20			0:20 Return to earth
6.1.6.7.22	Translate robotics to tools area - secure tools/effectors		Control console, SS computer CCIV		0:05				
6.1.6.7.23	Secure robotics		Control console, SS computer		0:02				· -

## CRYOGENIC SPACE-BASED OTV LOGISTICS SUPPORT

Provided are the logistics support operations associated with the Cryogenics SBOTV and its attendant accommodations.



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LOGISTICS SUPPORT-CRYOGENIC

KS				re segregated testing or eturn to	· return to
REMARKS				Damaged units are segregated  For diagnostic testing or  for immediate return to  earth	1:00- Damaged units - return to 2:00   earth
MANHOURS VA   TOTAL	6:00 -	3:00-	1:00-	1:00-	1:00-
MAN					
CREW SUPPT		<del></del>			
CREW	6:00 - 6:00- 17:00 17:00	3:00- 3:00- 10:00 10:00	1:00- 1:00-	1:00-11:00-4:00	1:00- 1:00- 2:00  2:00
TRNG   TIME	17:00	3:00-	1:00-	1:00. 4:00	1:00
TRNG		 	7	~	
requirements Tools	Control console, SS computer, RMS, robotics, CCTV, test equipment		Control console, SS computer, RMS, robotics, CCTV	Control console, SS computer, CCTV	Control console, SS computer, test equipment, robotics
FACILITIES	SS hangar, lighting, power				
TASK	Logistics Support - Cryogenic	OTV Part or Component Delivery	Translate parts/components to storage area	Conduct visual inspection	Conduct diagnostic testing
SEQUENCE	7.1	7.1.1	7.1.1.1	7.1.1.2	7.1.1.3

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LOGISTICS SUPPORT-CRYOCENIC

LOGISTICS SUPPORT-CRYOGENIC

SHEET 3 of 3

SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	PPT	MANHOURS	S
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TIME	IVA	EVA   E	EVA   TOTAL	AL REMARKS
7.1.3	Part or Component Processing - Serviceable								
7.1.3.1	Innediate Use				0:40	0:40		- <del></del>	0,40
7.1.3.1.1	Translate components to OTV processing or buildup area	. – –	Control console, SS computer, CCTV, robotics, RMS		0:20	0:20		. <u>.</u> .	0:20 20 minutes/component
7.1.3.1.2	Translate unserviceable OTV parts/components to storage area for processing.		Control console, SS computer, CCTV, robotics, RMS		0:20	0:20	<del></del> -	- <b>-</b>	0:20
7.1.3.2	Store for Future Missions				1				
7.1.3.2.1	Translate parts/components to designated storage area		Control console, SS computer, CCTV, robotics, RMS	~~	0:20	0:20		- <u>-</u>	0:20   20 minutes/component
7.1.3.2.2	Upon removal follow Sequence 7.1.3.1								
	•	•		-	_	-	-	-	-

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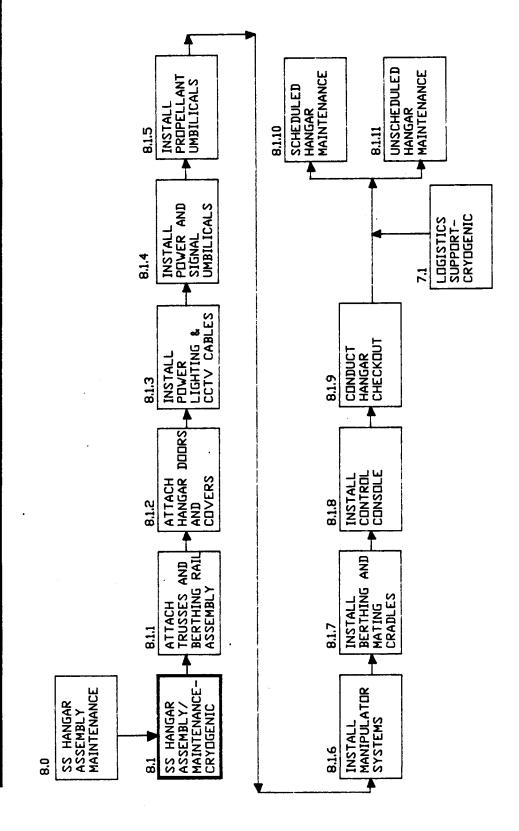
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# CRYOGENIC SPACE-BASED OTV HANGAR ASSEMBLY & MAINTENANCE

outer shell, manipulator systems, berthing/mating cradles, and umbilicals as well as long term maintenance All of the operations associated with initial assembly of the hangar, including trusses and rails, operations, are identified. Most of the initial hangar assembly must be accomplished by EVA until the robotic arms are installed and operational.





SHEET 1 of 23 SPACE STATION HANGAR ASSEMBLY AND MAINTENANCE - CRYOGENIC

SPOILENCE			REQUIREMENTS		FUNC	CREW SUPPT	UPPT	MANI	MANITOURS	
NUMBER	TASK	FACILITIES	S	TRNG	П	IVA	EVA	EVA 17	TOTAL	REMARKS
8.1	Space Station Hangar Assembly and Maintenance	Space station power, lighting.	SS computer, control console, MRMS, CCIV, special assembly tools, MMU's, software, test equipment	1	87:15	87:15	67:35	87:15 67:35 135:10 222:25	222:25	
8.1.1	Attach Trusses and Berthing Rail Assembly	MRMS Space station power, lighting,		'	19:00	19:00 14:40		29:20	48:20	
8.1.1.1	Load space station hangar assembly program		SS computer, software	8	0:15	0:15			0:15	
8.1.1.2	Translate MRMS to shuttle docking area - obtain truss assembly module		SS computer, MRMS, CCTV, control console	8	1:45	1:45	. — — —		1:45	Truss is removed from shuttle by shuttle RMS. 7 trusses - 15 min/truss
8.1.1.3	Translate MRMS to hangar assembly area		SS computer, control console, MRMS, CCTV	~	2:20	2:20			2:20	7 trusses - 20 min/truss
8.1.1.4	Open truss module - assemble first truss - attach to space station interface and latch in place		SS computer, control console, MRMS, CCTV	რ	12:15   12:15   12:15	12:15		24:30	36:45	Repeat until 7 trusses are installed 1:45/truss
8.1.1.5	Assemble berthing rail assembly - attach to space station and hangar truss assembly		Control console, SS computer, MRMS, CCIV	m	2:25	2:25	2:25	4:50	7:15	

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SEQUENCE			REQUIREMENTS	ENTS		E	FUNC	CREW SUPPT	JPPT	MANHOURS	URS	
NUMBER	TASK	FACILITIES		TOOLS	TRNG		TIME	IVA	EVA	EVA [1	TOTAL	REMARKS
					<b>-</b> -						70.00	
7.1.0	Install Hangar Cover	Space	•				5:25	15:25	12:30	15:25 15:25 12:30 25:00	[7:00 	
		power, lighting										
8.1.2.1	Translate MRMS to shuttle docking	HRMS	SS computer, control console,	control con	  Bole,  2		1:15 1:15	1:15			1:15	i 1:15  Hanger sections are shipped
•	area - obtain hangar section modules		MRMS, CCTV									to space station in 27'x 235' sections
					.—-		. —-		-			req'd, 15 min/section
8.1.2.2	Translate MRMS to hangar assembly area		SS computer, control console, CCTV, MRMS	control con	Bole, 1		1:40 1:40	1:40			1:40	1:40 20 min/section
8.1.2.3	Unpack hanger sections and attach to truss		SS computer, control console, CCTV	control con	1801e,	- <u>-</u>	- <u>[</u>	00:01		20:00	30.00	10:00 10:00 10.00 20:00  30.00  2.0 hrs per section
8.1.2.4	Inject foam into hanger sections						2:30	2:30	2:30	2:30  2:30  2:30  5:00	7:30	7:30 30 minutes per section
	_	_			_	_	_	_	_	_	-	

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	REMARKS		Module is removed from shuttle cargo bay by the shuttle RMS	Module is removed from shuttle cargo bay by the shuttle RMS	3:30/complete door assembly	l hr/complete door assembly		Correct anomolies
IRS	TOTAL	0	0.30   Ho   sh   sh	0:40   Mo   8h   8h		6:00 1	00:9	3:00
MANHOURS	EVA  T(	4:00			4:00 21	- 100:7	00:4	2:00
IPPT	H	13:10 12:00 24:00 37:10			7:00  7:00  7:00 14:00 21:00	2:00	2:00	1:00
CREW SUPPT	I VA	13:10	0:30	0:40  0:40	7:00	2:00  2:00	2:00	1.00 1:00 1:00
FUNC	П	13:10	0:30 0:30	0:40	7:00	2:00	2:00	1.00
F	TRNC		7		m .	ო 		e e
REQUIREMENTS			SS computer, MRMS, CCTV,   control console	SS computer, MRMS, CCTV, control console	SS computer, MRMS, CCTV, control console	SS computer, MRMS, CCIV, control console	SS computer, MRNS, CCTV, control console	SS computer, MRMS, CCTV control console
	PACILITIES	Space station power, lighting,						
	TASK	Attach Hanger Doors and Covers	Translate MRMS to shuttle docking area - obtain door assemblies and covers	Translate MRMS to hangar assembly area	Assemble door frame and attach to hangar mounting points	Attach door operating	Attach door cover and inject	Verify doors opens and close properly.
SEQUENCE	NUMBER	8.1.3	8.1.3.1	8.1.3.2	8.1.3.3	8.1.3.4	8.1.3.5	8.1.3.6

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SFOUENCE			REQUIREMENTS		FUNC	CREW SUPPT		MANIIOURS	URS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	VAI	Lſ	EVA 1	TOTAL	REMARKS
8.1.4	Install Power, Lighting, Signal and CCTV Cables	Space station power, lighting,		·	17:50	17:50 17:50 15:30 31:00	15:30		48:50	
8.1.4.1	Translate MRMS to shutte docking area - obtain power, lighting and CCTV cable modules		SS computer, MRMS, CCTV, control console	~	1:00	1:00			1:00	Modules are removed from shuttle cargo bay by the shuttle RMS 15 min/module - 4 each
8.1.4.2	Translate MRMS to hanger		SS computer, control console	7	1:20	1:20			1:20	20 min/module - 4 each
8.1.4.3	Unpackage power cables - install and secure as designated		SS computer, MRMS, CCTV, control console	м 	3:00	3:00	3:00	9:00	00:6	Conduct continuity checks - correct anomolles - secure at power distribution point
8.1.4.4	Unpackage lighting cables - install and secure as designated		SS computer, HRMS, CCTV, control console, test equipment	m 	3:00	3:00	3:00	9:00:	9:00	Conduct continuity checks - correct anomolles - secure at power distribution point
8.1.4.5	Install and secure lighting fixtures		SS computer, MRMS, CCTV, control console	e ———	1:30	1:30	1:30	3:00	4:30	
8.1.4.6	Unpackage CCTV cables - Install and secure as designated		SS computer, MRMS, CCTV, control console, test equipment	m 	3:00	3:00	3:00	00:9	00:6	Conduct continuity checks correct anomolies - secure at power distribution point
8.1.4.7	Install and secure CCIV cameras/monitors		SS computer, MRMS, CCTV, control console	m 	1:30	1:30	1:30	3:00	4:30	
8.1.4.8	Unpackage signal cables - install and secure as designated		SS computer, HRMS, CCTV control console	e 	3:00	3:00	3:00	00:9	00:6	Conduct continuity checks, correct anomolies, secure to S.S. signal distribution panel
8.1.4.9	Connect power cables to designated main power distribution points		SS computer, MRMS, CCTV control console	m 	0:30	0:30	0:30	1:00	1:30	Verify power levels where possible

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SEQUENCE			REQUIREMENTS		$\Box$	1-2		圐	URS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	VAI	EVA	EVA 1	TOTAL	REMARKS
8.1.5	Install Power and Signal Umbilicals	Space station power, lighting,			6:15	6:15	5:05	5:05 10:10	16:25	
8.1.5.1	Translate MRMS to shuttle docking area - obtain power and signal umbilicals and reels		SS computer, MRMS, CCTV, control console.	~	0:30	0:30			0:30	Modules are removed from shuttle bay with shuttle RMS 2 modules - 15 min/module
8.1.5.2	Translate MRMS to Hangar assembly area		SS computer, MRMS, CCTV, control console	~	04:0	0:40			0:40	2 modules - 20 min/module
8.1.5.3	Discondect power to power and signal cables		SS computer, HRMS, CCTV, control console.	۳ 	0:15	0:15	0:15	0:30	0:45	
8.1.5.4	Unpackage power umbilical and reel assembly		SS computer, MRMS, CCTV, control Console	რ 	0:15	0:15	0:15	0:30	0:45	Reel assembly used for unbilical management
8.1.5.5	Install and secure power umbilical and reel assembly		SS computer, MRMS, CCTV, control console, Test equipment	ო 		5:00	2:00	6:00	00:9	operation checks.
8.1.5.6	Unpackage signal umbilical and reel assembly.		SS computer, HRMS, CCTV, control console	e 	0:15	0:15	0:15	0:30	0:45	Reel assembly used for umbilical management.
8.1.5.7	Install and secure signal umbilical and reel assembly		SS computer, MRMS, CCTV, control console, Test equipment	ო 	2:00	2:00	2:00	4:00	00:9	
8.1.5.8	Connect power and signal umbilicals at respective distribution points		SS computer, MRMS, CCTV, control console.	m 	0:20	0:20		0:40	1:00	Conduct continuity and reel operation checks

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SFOUENCE			REQUIREMENTS		FUNC	CREW SUPPT	UPPT	MANHOURS	URS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG TIME	TIME	VAL	EVA	EVA	TOTAL	REMARKS
8.1.6	Install Propellant Umbilicals	Space station power,		1	3:00	3:00	2:25 4:50	4:50	7:50	
8.1.6.1	Translatre MRMS to shuttle docking   area - obtain propellant umbilical	MRMS	SS computer, MRMS, CCIV, control console.		0:15	0:15			0:15	0:15 Module removed from shuttle   bay with shuttle RMS 
8.1.6.2	Translate MRMS to hangar assembly area		SS computer, MRMS, CCTV, control console.		0:20	0:20			0:20	
8.1.6.3	Unpackage propellant umbllical - Install and secure at designated location		SS computer, MRMS, CCTV control console	e 	2:15	2:15 2:15 2:15 4:30	2:15	4:30	6:45	·
8.1.6.4	Verify umbilical connection   properly seated			<u>ო</u>	0:10	0:10	0:10 0:10 0:20	0:20	0:30	0:30 Leak check conducted during   initial propellant line   chill down - correct   anomolies.

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SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	TAM	MANHOURS	URS	
NUMBER	TASK	FACILITIES	LOOLS	TRNG	TIME	I W	EVA [	EVA T	TOTAL	REMARKS
8.1.7	Install Berthing and Mating Cradles	Space station power,		1	6:35	6:35	5:25 10:50		17:25	
8.1.7.1	Translate MRMS to shuttle docking area - obtain berthing structure	MKMS	SS computer, WRMS, CCTV, control console	2	0:30	0:30			0:30	2 modules - 15 min/module
8.1.7.2	Translate MRMS to hangar assembly area		SS computer, MRMS, CCTV, control console		0:40	0:40			0:40	20 min/module
8.1.7.3	Unpackage berthing cradle		SS computer, MRMS, CCTV, control console	რ ———-	0:50	0:20	0:20	0:40	1:00	
8.1.7.4	Install and secure berthing cradle to rail assembly		SS computer, MRMS, CCTV, control console	e	1:30	1:30	1:30	3:00	4:30	
8.1.7.5	Translate MRMS to shuttle docking area secure mating cradles		SS computer, MRMS, CCTV, control console	~	0:45	0:45	0:45	1:30	2:15	3 modules - 15 min/module 2 payload, 10 OMV
8.1.7.6	Translate MRMS to hangar assembly area	·	SS computer, MRMS, CCTV, control console	~	1:00	1:00	1:00	2:00	3:00	20 min/module
8.1.7.7	Unpackage mating cradles		Control console, SS computer, CCTV	e	0:20	0:20	0:20	0:40	1:00	
8.1.7.8	Install and secure mating cradles to rail assembly		SS computer, MRMS, CCTV control console	m 	1:30		1:30  1:30	3:00	4:30	

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REMARKS					
MANHOURS EVA TOTAL	4:00	0:15	0:15	1:00 1:30	2:00
CREW SUPPT IVA EVA	3:00	0:15 0:15	0:15  0:15	0:30 0:30	2:00  2:00
TRNG TIME	ι 	°	0 	°	2
REQUIREMENTS TOOLS		SS computer, MRMS, CCTV, control console	SS computer, MRMS, CCTV, control console		
FACILITIES	Space station power, lighting,				
TASK	Hangar Control Console Installation	Translate MRMS to shuttle docking area - obtain hangar control console	Translate MRMS to space station airlock	Translate hangar control console through airlock.	Install and secure hangar control console
SEQUENCE NUMBER	8.1.8	8.1.8.1	8.1.8.2	8,1,8,3	8.1.8.4

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	REMARKS		Correct anomolies	Correct anomolies	Correct anomolles	Correct anomolies	Correct anomolies	Correct anomolies	Correct anomolies	See 9.1 Robotics Assembly and maintenance	Correct anomolies	Verified through above steps.
MANHOHRS	TOTAL	3:00	0:15	0:15	0:15	0:15	0:15	0:15	0:30	0:30	0:30	ı 
WAN	EVA					_ شد پـــ «						
Tagis Sippt	A EVA	3:00	0:15	0:15	0:15	0:15	0:15	0:15	0:30	0:30	0:30	·
	1 [	3:00	0:15 0	0:15 0	0:15  0	0:15 0	0:15  0	0:15  0	0:30	0:30	0:30	1
PINC		 1	 	 	- <del></del> -	- <del></del> -	 2			 ~	- <del></del> -	~
	TRNC											
OFWAMA OF LOSS		:	SS computer, hangar control console	SS computer, hangar control console	SS computer, hangar control console	CC computer, hangar control console	SS computer, hangar control console	SS computer, hangar control console	SS computer, hangar control console.	SS computer, hangar control console	SS computer, hangar control console	SS computer
	FACILITIES	Space station power, lighting										
	TASK	Conduct Hangar Checkout	Verify operations of hangar doors	Verify power levels through- out hangar	Verify operation of hangar lighting console	Verify operation of CCTV system	Verify operations of power umbilical	Verify operation of signal umbilical	Verify operation of propellant umbilical	Verify operation of hangar robotic system	Verify operation of berthing and mating cradies	Verify control consule operations
aonanoas	NUMBER	8.1.9.1	8.1.9.1	8.1.9.2	8.1.9.3	8.1.9.4	8.1.9.5	8.1.9.6	8.1.9.7	8.1.9.8	8.1.9.9	8.1.9.10

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	REMARKS						0:30 Visual and electronic Inspection for excessive Wear, cracks, warms, etc.	
RS	TOTAL		1:00		<del></del> -	0:30	0:30 Visual Inspect	<u>'</u>
MANHOURS	EVA   TO	 			·	·		
CREW SUPPT	IVA EVA		1:00 1:00	·		0:30	0:30	
FUNC	TIME		1:0			0:30	0:30	
	TRNG	<del></del>	' 			~	~	
REQUIREM	TOOLS		SS computer, control console, robotics, CCIV, test equip-	ment,	Control console	SS computer, control console	SS computer, control console, robotics, CCIV, test equipment.	Control console
	FACILITIES		Space	power, Lighting				
	TASK	Schedule Hangar Maintenance	Inspect Berthing Rail Assembly		Turn power off	Clean berthing rail assembly	Inspect berthing rail assembly	Turn power on
SEQUENCE	NUMBER	8.1.10	8.1.10.1		8:1.10.1.1	8.1.10.1.2	8.1.10.1.3	8.1.10.1.4

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	REMARKS			<u></u>	Usual and electronics   Inspection for excessive   wear, cracks, etc.			· [0]	10 Check for binding in joints	
MANHOURS	TOTAL	355	'	1:30	0:30	 06:-	1	0:10	0:10	0:02
_	EVA	5:00		8		6:				
CREW SUPPT	EVA			<del></del> -				<del></del>		
CREW	IVA	1:55	'	0:30	0:30	0:30	! 	0:10	0:10	5 0:05
FUNC	TIME	1:55	ı	0:30	0:30	0:30	' 	0:10	0:10	0:02
	TRNG	1		~	7	~	- 	~	~	7
REQUIREMENTS		SS computer, control console, robotics, CCTV	Control console	SS computer, control console robotics, CCTV	SS computer, control console, robotics, CCTV, test equipment.	SS computer, control console, robotics, CCTV		S computer, control console	SS computer, control console test equipment.	SS computer, control console
	FACILITIES	Space station power, Lighting								
	TASK	Inspect and Lubricate Berthing Structures	Turn power off	Cleaning berthing cradles	Inspect berthing cradles	Lubricate berthing cradle joints, and rail mounting points	Turn power on	Translate berthing cradle along rails	Collapse and extend berthing cradle	Verify OTV, OMV and payload locking mechanisms operational
SEOIIFMCE	NUMBER	8.1.10.2	8.1.10.2.1	8.1.10.2.2	8.1.10.2.3	8.1.10.2.4	8.1.10.2.5	8.1.10.2.6	8.1.10.2.7	8.1.10.2.8

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- I	-			·		0:10 Correct anomolies
MANHOURS	1014	4:25	2:15	0:30	1:30	
	4	2:30	1:30		8	
CREW SUPPT	EVA		. — — –			- <del>-</del>
CREV	4	1:55 1:55	0:45  0:45	0:30  0:30	0:30 0:30	0:10 0:10
		1:55	0:45	0:30	0:30	0:10
1771	IKW 111ME	1	8	8	8	-
REQUIREM	TOOLS	SS computer, control console, CCTV, robotics, test equipment	SS computer, control console, CCTV, robotics	SS computer, control console, CCTV, robotics, test equipment	SS computer, control console, CCIV, robotics	SS computer, control console
	FACILITIE					
	TASK	Inspect and Lubricate Hangar Door Mechanism	Clean hangar door mechanism	Inspect hangar door mechanism	Lubricate hangar door mechanism	Exercise hangar door mechanism through full
SEQUENCE	NUMBER	8.1.10.3	8.1.10.3.1	8.1.10.3.2	8.1.10.3.3	8.1.10.3.4

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(S					89	<b>8</b>
REMARKS					Correct anomolies	Correct anomolies
MANHOURS I	2:10	0:45	0:30	0:30	0:10	0:15
EVA	0:50	30		.50		
CREW SUPPT	1:20	0:15	0:30	0:10	0:10	151:
FUNC CREW	1:20	0:15  0	0.30	0:10	0.10	0:15 0:15
TRNG T	1	~	~~~~	~~~	~	
REQUIREMENTS TOOLS	SS computer, control console, CCTV, robotics, test equipment	SS computer, control console, CCTV, robotics	SS computer, control console, CCTV, robotics, test equipment	SS computer, control console, CCIV, robotics	SS computer, control console, CCTV	SS computer, control console
FACILITIES	Space station power, lighting					
TASK	Inspect and Lubricate Umbilicals and Umbilical Management reels	Clean umbilical management reels	Inspect umbilicals and umbilical management reels	Lubricate umbilical manage- ment reels	Verify umbilical interfaces mate properly	Operate umbilical management reels through full range
SEQUENCE NUMBER	8.1.10.4	8.1.10.4.1	8.1.10.4.2	8.1.10.4.3	8.1.10.4.4	8.1.10.4.5

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HOURS REMARKS	1:45	0:45	0:20	00:0	0.10
EVA	0:50	0 <u>6</u>		.50	
FUNC   CREW SUPPT   TIME   IVA   EVA	0:55 0:55	0:15  0:15	0.20 0:20	0.10 0:10	0:10 0:10
TRNG	1	7	~	~~~	
REQUIREMENTS TOOLS	SS computer, control console, CCTV, robotics	SS computer, control console, CCTV, robotics	SS computer, control console, CCTV, robotics	SS computer, control console, CCTV robotics	SS computer, control console
PACILITIES	Space station power, lighting,				
TASK	Inspect and Lubricate CCTV	Clean CCTV lenses and mounting brackets	Inspect lenses and mounting brackets	Lubricate mounting brackets	Operate CCTV through full
SEQUENCE NUMBER	8.1.10.5	8.1.10.5.1	8.1.10.5.2	8.1.10.5.3	8.1.10.5.4

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TASK	PACILITIES	REQUIREMENTS TOOLS TR SS computer, control console,   -	TRNC -	TRNG TIME	FUNC   CREW SUPPT   TIME   IVA   EVA	EVA TOTAL   0:45	REMARKS
	station power, lighting, signal	calibration equipment, test equipment	. <del></del>			 	
Calibrate hangar contamination monitoring equipment		SS computer, control console, calibration equipment	~	0:15	0:15  0:15	 0:15	
Conduct contamination survey		SS computer, control console, test equipment	~ <del></del>	0:30  -	0:30 0:30	 0:30	

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SEOUENCE						-	$\vdash$	131	  -
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	IVA EVA	VA EVA	A TOTAL	TAL REMARKS
8.1.11	Unscheduled Hangar Maintehance		SS computer, control console, CCIV, robotics, tools/ effectors, repair kits, test equipment		<b></b>				
8.1.11.1	Repair Hangar Walls and Doors	Space station power, lighting,			0:40	0:15		ol 	0:15
8.1.11.1.1	Translate robotics to tool storage area - obtain and stow tools / effectors		Control console, SS computer		0:50				
8.1.11.1.2	Translate robotics to parts storage - obtain and stow repair kits		Control console, SS computer		0:05				
8.1.11.1.3	Translate robotics to work   site - prepare damaged area   for patching - apply patch		Control console, SS computer   robotics, CCIV, tools/		0:15	0:15			0:15
8.1.11.1.4	Translate robotics to parts storage - secure repair kit		Control console, SS computer	-	0:05				
8.1.11.1.5	Translate robotics to tool area - secure tools and effectors		Control console, SS computer	-	0:0				
8.1.11.1.6	Secure robotics.		Control console, SS computer		0:02				

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SECTIENCE						-		3	
NUMBER	TASK	FACILITIES	S	TRNC	TIME	IVA	EVA	EVA	TOTAL REMARKS
8.1.11.2	Remove and Replace Berthing Rails	Space station power, lighting	Control console, SS computer, CTV, robotics, tools/ effectors	·	3:30	2:40			2:40
8.1.11.2.1	Move berthing cradles away from work site location		Control console, SS computer	=	0:20				
8.1.11.2.2	Translate robotics to tool area - secure and stow tools and effectors.		Control control, SS computer	-	0:02				
8.1.11.2.3	Translate robotics to work site		Control control, SS computer		0:02				
8.1.11.2.4	Remove damaged section of berthing rails		Control control, SS computer, CCTV, robotics, Tools/ effectors	- -	1:00	1:00			1:00
8.1.11.2.5	Translate robotics to parts storage - secure damaged rail		Control control, SS computer, robotics, CCTV		0:15	0:15			0:15
8.1.11.2.6	Secure serviceable berthing   rail		Control control, SS computer, robotics, CCTV		0:05	0:05			0:05
8.1.11.2.7	Translate robotics and   berthing rail to work site		Control control, SS computer	~	0:15	0:15			0:15
8.1.11.2.8	Install serviceable berthing rail		Control control, SS computer, CCTV, robotics, tools/effectors	~	1:00	1:00	- <del></del> -		1:00
8.1.11.2.9	Translate robotics to parts area - dissassemble unserviceable berthing rail and package for shipment		Control control, SS computer, CCTV, robotics, tools/ effectors	-	0:15	0:15			0:15 Return to earth
8.1.11.2.10	Translate robotics to tool area - secure and store tools/effectors		Control control, SS computer	- -	0:05				
8.1.11.2.11	Secure robotics		Control control, SS computer	-	0:05				

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SEQUENCE			REQUIREM		П	-	HAN	MANHOURS	
NUMBER	TASK	FACILITIES		TRNG	TIME	IVA EVA	EVA	TOTAL	REMARKS
8.1.11.3	Remove and Replace Hangar Door Mechanism	Space station power, lighting,	Control console, SS computer, robotics, tools/effectors	1 	1:55	1:25		1:25	
8.1.11.3.1	Translate robotics to tool area - secure and stow tools/effectors		Control control, SS computer	- -	0:05				
8.1.11.3.2	Translate robotics to parts area - secure and stow replacement components		Control control, SS computer, CCTV, robotics		0:10				
8.1.11.3.3	Translate robotics to work site		Control control, SS computer		0:05				
8.1.11.3.4	Remove and stow door mechanism		Control control, SS computer, CCTV, robotics, tools/	r,	0:30	0:30		0:30	
8.1.11.3.5	Install new door mechanism		Control control, SS computer, CCTV, robotics, Tools/ effectors.	r, 2	0:30	0:30		0:30	
8.1.11.3.6	Conduct operational check   of door mechanism		Control control, SS computer		0:10	0:10		0:10	
8.1.11.3.7	Translate robotics to parts storage - secure unservice- able components and package		Control console, SS computer,		0:15	0:15		0:15	Return to earth
8.1.11.3.8	Translate robotics to tool area - secure and stow tools/effectors		Control control, SS computer		0:02				
8.1.11.3.9	Secure robotics		Control control, SS computer						

SPACE STATION HANGAR ASSEMBLY AND MAINTENANCE - CRYOGENIC

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SEQUENCE			REQUIREMENTS		П	3	$\vdash$	MANHOURS	
NUMBER	TASK	PACILITIES	TOOLS	TRING	TIME	IVA EVA	EVA	TOTAL	REMARKS
8.1.11.4	Remove and Replace CCTV Camera and Brackets	Space station power, lighting,	Control console, Ss computer, CCTV, robotics, tools/ effectors	·	1:25	0:55		0:55	
8.1.11.4.1	Translate robotics to tool area - secure and stow tools/effectors		Control control, SS computer		0:05				
8.1.11.4.2	Translate robotics to parts area - secure and stow replacement component		Control control, SS computer		0:10				
8.1.11.4.3	Translate robotics to work site		Control Console, SS computer		0:05				
8.1.11.4.4	Remove unserviceable   component		Control control, SS computer CCIV, robotics, tools/effectors	~	0:15	0:15		0:15	
8.1.11.4.5	Install replacement component		Control control, SS computer, CCTV, robotics, tools/	~	0:15	0:15		0:15	
8.1.11.4.6	Conduct system test of CCTV		Control control, SS computer		0:10	0:10		0:10	
8.1.11.4.7	Translate robotics to parts area - package unserviceable component		Control control, SS computer, CCTV, robotics, tools/ effectors	-	0:15	0:15		0:15	Return to earth
8.1.11.4.8	Translate robotics to tool area - secure and stow tools/effectors		Control control, SS computer		0:05				
8.1.11.4.9	Secure robotics		Control control, SS computer		0:05		_ ==		

SPACE STATION HANGAR ASSEMBLY AND MAINTENANCE - CRYOGENIC

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Remove and Replace Umbilicals Translate robotics to tool area - secure and stow tools/effectors Translate robotics to work site Translate RMS to work site - attach to unserviceable umbilical Verify umbilical is safe for removal Translate RMS and unservice- able umbilical Secure replacement umbilical and translate to work site	FACILITIES   Space   station   power,   lighting,   signal   signal   sea   sea	rol control, SS computer, rol control, SS computer, ctors, test equipment rol control, SS computer rol control, SS computer rol control, SS computer,	TRNG 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2:30 2:30 0:05 0:05 0:05 0:30 0:15	2:05 2:05 0:05 0:05 0:15	<u>                                     </u>	A TOTAL.  2:05  0:05  0:05  0:15	Power off/propellant purged
Install replacement umbilical	S S 4	Control control, SS computer, CCTV, robotics, RMS, Tools/ effectors.	8	0:30	0:30		0:30	
Disengage RMS and secure Verify umbilical operation		Control control, SS computer Control control, SS computer robotics, test equipment.	7 7	0:05	0:10		0:10	Propellant umbilical will be checked prior to next scheduled propellant transfer

SPACE STATION HANGAR ASSEMBLY AND MAINTENANCE - CRYOGENIC

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SEOHENCE			REQUIREMENTS		FUNC   CREW SUPPT   MANHOURS	CREW S	UPPT	MANIIC	URS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME IVA EVA EVA	IVA	EVA	EVA	TOTAI.	REMARKS
8.1.11.5.11	Translate robotics to parts area - package unserviceable		Control control, SS computer robotics, CCTV. robotics,		0:15	0:15 0:15 			0:15	0:15 Return to earth
8.1.11.5.12	umbilical Translate robotics to tool area - secure and stow		CCIV. Control control, SS computer		0:05					
8.1.11.5.13	tools/effectors   Secure robotics		Control control, SS computer		0:05					

SPACE STATION HANGAR ASSEMBLY AND MAINTENANCE - CRYOGENIC

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SEQUENCE NUMBER	TASK	FACILITIES	REQUIREMENTS TOOLS	TRNC	FUNC	CREW SUPPT IVA EVA	1	MANHOURS A TOTAL	REMARKS	1
8.1.11.6	Remove and Replace Umbilical Reels	Space station power, lighting,	S computer,	1	<u> </u>	1:55	i			1
8.1.11.6.1	Translate Robitics to tool area - secure and atow tools/effectors		Control control, SS computer		0:05					
8.1.11.6.2	Translate robotics to work site		Control control, SS computer		0:03	· 				
8.1.11.6.3	Translate RMS to work site - attach to reel assembly		Control control, SS computer	- 	0:05	0:05		0:02		
8.1.11.6.4	Verify umbilical reel is safe for removal		Control Console, SS computer	- 	0:03				Power off	
8.1.11.6.5	Disconnect umbilical reel assembly		Control control, SS computer, CCTV, robotics, tools/ effectors	~	0:30	0:30		0:30	- <del>-</del>	
8.1.11.6.6	Translate RMS and reel assembly to parts are and secure		Control control, SS computer, CCIV, RMS	~	0:10	0:10		0:10		
8.1.11.6.7	Secure replacement reel assembly and translate to work site		Control control, SS computer CCIV, RMS	7	0:15	0:15		0:15		
8.1.11.6.8	Install and secure reel assembly		Control control, SS computer, CCTV, robotics, RMS, tools/ effectors	7	0:30	0:30		0:30		
8.1.11.6.9	Disengage RMS and secure		Control control, SS computer	-	0:05					
8.1.11.6.10	Verify umbilical/reel operational		Control control, SS computer, robotics	~	0:10	0:10		0:10		
8.1.11.6.11	Translate robotics to parts area - package reel assembly		Control control, SS computer, CCTV, RMS, robotics, tools/ effectors.		0:15	0:15		0:15	Return to earth	
8.1.11.6.12	Translate robotics to tool area - secure and stow tools		Control control, SS computer	-	0:02					
8.1.11.6.13	Secure robotics		Control control, SS computer	- 	0:05		AF	TINI	MARTIN MARIETTA	
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SPACE STATION HANGAR ASSEMBLY AND MAINTENANCE - CRYOGENIC .

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SEOTENCE			STATEMENTAL			JNIJ	Tagin Cilbbr	<u> </u>	MANUOTIDE	1 30	
NUMBER	TASK	PACTLITIES	TOOLS		TRNG	▔┌╴	TVA		EVA TO	TOTAL	REMARKS
8.1.11.7	Remove and Replace Lighting Space System static power light	Space station power, 11ghting				25	T 81			0:30	
8.1.11.7.1	Translate robotics to tool area - secure and stow tools/effectors		Control control, SS computer	computer		0:05				- <del></del>	
8.1.11.7.2	Translate robotics to parts area - secure and stow replacement components		Control control, SS computer	computer		0:05					
8.1.11.7.3	Translate robotics to work site		Control Console, SS computer	computer		0:05				· 	
8.1.11.7.4	Remove and replace defective component		Control control, SS computer CCTV, roboticm, toolm/ effectorm.	computer	7	0:15	0:15	`		0:15	
8.1.11.7.5	Translate robotics to parts area - package unservice- able components		Control control, SS computer, CCTV, robotics.	computer,		0:15	0:15			0:15  Return	Return to earth
8.1.11.7.6	Translate robotics to tool area - secure and stow tools/effectors		Control control, SS computer	computer		0:02					
8.1.11.7.7	Secure robotics	·	Control control, SS computer	computer		0:0					
	•	•		•	•	•	•	•	•	•	

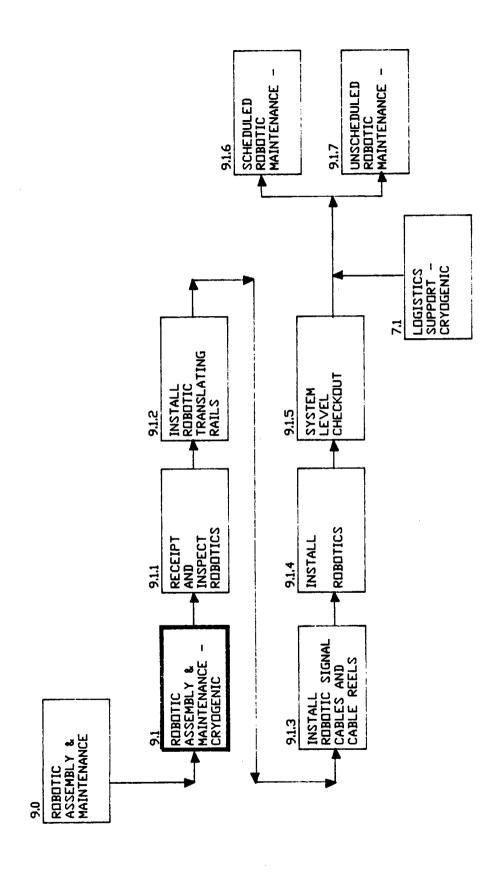
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## CRYOGENIC SPACE-BASED OTV ROBOTIC ASSEMBLY & MAINTENANCE

Installation of the robotics system, performed primarily by EVA, and maintenance of the system, performed robotically, is identified on the facing page functional flow and following requirements definition set.

## MARTIN MARIETTA



ROBOTIC ASSEMBLY & MAINTENANCE -CRYOGENIC

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ROBOTIC ASSEMBLY AND MAINTENANCE - CRYOGENIC

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SEQUENCE NUMBER	TASK	PACILITIES	REQUIREMENTS TOOLS	TRNC	FUNC	CREW SUPPT		EVA   TOTAL	REMARKS
9.1	Robotic Assembly and Maintenance - Cryogenic	Space station power, lighting, signal,	Control console, SS computer, CCTV, tools/effectors, test equipment		24:20	24:20	13:00	24:20   24:20   21:00   42:00   66:20	
9.1.1	Receipt and Inspect	Space station power, lighting,			3:20	3:20	1:00	2:00 5:20	
9.1.1.1	Translate MRMS to shuttle  docking area - secure  robotics module		MRMS, control console, SS   computer, CCTV	8	1:00	1:00	- <del>-</del>	- 1:00	Robotic modules removed from shuttle by shuttle RMS. 15 mins/robotics module - 4 each.
9.1.1.2	Translate MRMS to SS hangar		MRMS, control console, SS computer, CCTV	7	1:20	1:20		-   1:20	20 min/robotics module - 4 each.
9.1.1.3	Unpackage robotics module, store components			-	1:00	1:00	1:00	2:00  3:00	Visual inspection (15 min/module) accomplished. Repeat steps 9.1.1.1 - 9.1.1.3 until all modules are delivered to Hangar.

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ROBOTIC ASSEMBLY AND MAINTENANCE - CRYOGENIC .

SEQUENCE			REQUIREMENTS		PUNC   CREW SIIPPT	CREWS	II DAT	MANHOTIRS	OIRS	
NUMBER	TASK	FACI LITIES	LOOLS	TRNG TIME	TIME	IVA	EVA	EVA   EVA   TOTAL	TOTAL	REMARKS
9.1.2	Install Robotic Translating	Space			8.00	8:0	7:00	7:00 14:00 22:00	22:00	
9.1.2.1	te MRMS to shuttle docking obtain translating rails	power,	SS computer, control console,	~~~	00:1	8:			8	
9.1.2.3	Assemble, and attach robotic translating rails at designated locations		SCTV, tools		00:9	6:00	00:9	12:00	00:81	6:00 6:00 12:00 18:00 Attached parallel and
9.1.2.2	Verify attachments are secure.		SS computer, control console, test equipment	e	1:00   1:00   1:00   2:00   3:00	1:00	1:00	2:00	3:00	

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ROBOTIC ASSEMBLY AND MAINTENANCE - CRYOGENIC

	REMARKS		4:00  4:00  8:00 12:00   1 hr/module - 4 each	1:00 1:00 2:00 3:00 Cable management - 15 min/ 	1:00   1:00   1:00   2:00   3:00   15 min/module
URS	TOTAL	8:00	12:00   1	3:00	3:00
MANIC	EVA 17	12:00	8:00	2:00	2:00
UPPT	EVA	00:9	4:00	1:00	1:00
CREW S	IVA EVA	6:00 6:00 12:00 18:00	4:00	1:00	1:00
FUNC   CREW SUPPT   MANITOURS	TIME	9:00	4:00	1:00	1:00
	TRNG		——- ო	m 	- <b>-</b> -
REQUIREMENTS	TOOLS	Control console, SS computer,  CCTV, tools, test equipment	Control console, SS computer	SS Computer, CCTV	Control console, SS computer,  test equipment
	FACILITIES	Space   station   power,   lighting			
	I TASK	Install Robotic Signal/Power Space Cables and Cable Management static Reels power light	Install cable and cable reels	Verify proper cable reel operation	Verify continuity and signal   transmission
SEQUENCE	NUMBER	9.1.3	9.1.3.1	9.1.3.2	9.1.3.3

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ROBOTIC ASSEMBLY AND MAINTENANCE - CRYOGENIC

SHEET 4 of 7

SEDITENCE			REQUIREMENTS		Ī	FUNC	FUNC CREW SUPPT   MANHOURS	JPPT	MANIFO	URS	
NUMBER	TASK	FACILITIES	TOOLS		TRNG   TIME	г	IVA	EVA   E	EVA   TOTAL	OTAL	REMARKS
9.1.4	Install Robotics	Space station power, lighting	Control console, SS computer,	S computer,	,	7:00	7:00 7:00 14:00 21:00	7:00	4:00 2	1:00	
9.1.4.1	Attach robotics to translating rails		Control console, SS computer, CCTV	S computer,		5:00	5:00 5:00 10:00 15:00	5:00[1	0:00	2:00	1:15/module - 4 each
9.1.4.2	Attach signal/power cables to robotics		Control console, SS computer, CCTV	S computer,	- <del></del> -	1:00	1:00 1:00 2:00 3:00	1:00	2:00	3:00	
9.1.4.3	Verify interfaces at all attaching points		Control console, SS computer,	S computer,	e	1:00	1:00   1:00   1:00   2:00   3:00	1:00	2:00	3:00	

ROBOTIC ASSEMBLY AND MAINTENANCE - CRYOGENIC

SEQUENCE			REQUIREMENTS		FUNC   CREW SUPPT   MANHOURS	CREW S	UPPT	MANH	OURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	IVA	EVA	EVA	rotal.	REMARKS
9.1.5	System Level Checkout	Space station power, lighting, signal	Control console, SS computer	2	1:00	1:00			1:00	Correct anomolies

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ROBOTIC ASSEMBLY AND MAINTENANCE - CRYOGENIC

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SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	_	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	IVA EVA	EVA	TOTAL.	REMARKS
9.1.6	Inspect and Lubricate RMS and Robotic Arms	Space station power, lighting signal			1:45	1:45	9	2:45	
9.1.6.1	Power-off					<u>-</u>	1	· ·	
9.1.6.2	Clean RMS and robotic arms		SS computer, control console robotics, CCTV, test equipment.	~	0:15	0:15	0:30	0:45	Sequentially - operations I robotic system.
9.1.6.3	Inspect RMS or robotic arms		SS computer, control console robotics, CCTV, test equipment.	2	0:30	0:30		0:30	
9.1.6.4	Lubricate RMS and robotic arms		SS computer, control console	2	0:15	0:15	0:30	0:45	
9.1.6.5	Power - On				1	- <del>-</del> -			
9.1.6.6	Verify full operational range of RMS and robotics		SS computer, control console	7	0:15	0:15		0:15	
9.1.6.7	Inspect tools and effectors		SS computer, control console, CCTV, robotics.	2	0:30	0:30		0:13	

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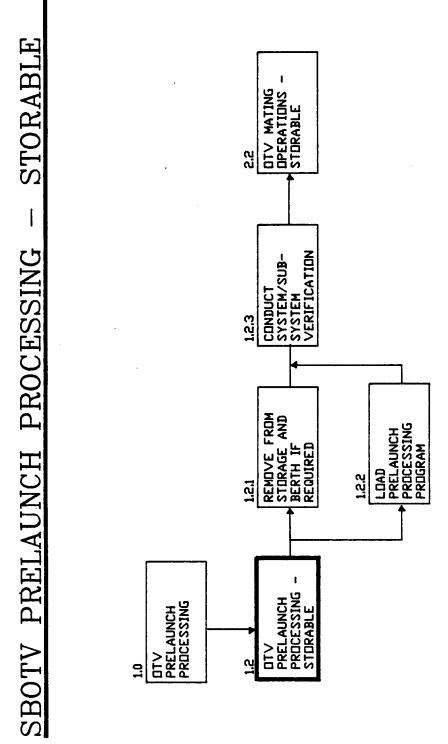
ROBOTIC ASSEMBLY AND MAINTENANCE - CRYOGENIC

SEOTIFICE			REDUIREMENTS		FUNC	CREW SU	_	MANHOURS	
NUMBER	TASK	FACTLITIES	TOOLS	TRNC	TIME	IVA EVA	囯	TOTAL	REMARKS
9.1.7	Remove and Replace RMS or Robotics	Space station power, lighting,		·	3:15	1:55- 2:55		1:55-	
9.1.7.1	Translate robotics to tool area - secure and stow tools/effectors		Control console, SS computer		0:02				
9.1.7.2	Translate robotics to the location of the unserviceable robotic		Control console, SS computer		0:02	. — — — — — — — — — — — — — — — — — — —			
9.1.7.3	remove unserviceable component		Control console, SS computer CCTV, robotics, tools/ effectors		0:30-  1:00	1:00		1:00	
9.1.7.4	Translate unserviceable component to parts storage and secure		Control console, SS computer	.t	0:10	0:10		0:10	
9.1.7.5	Secure serviceable component - translate to work site		Control console, SS computer		0:15	0:15		0:15	
9.1.7.6	Install serviceable component		Control console, SS computer, CCTV, robotics, tools/ effectors	r,	0:30- 11:00	0:30- 1:00		   1:00 	
9.1.7.7	Conduct system check of repaired robotic		Control console, SS computer		0:15	0:15		0:15	
9.1.7.8	Translate robotics to parts storage - package unservice- able component		Control console, SS computer		0:15	0:15		0:15	Return to earth
9.1.7.9	Translate robotics to tool area - secure and store tools/effectors		Control console, SS computer		0:05				
9.1.7.10	Secure robotics		Control console, SS computer	- <del>-</del> -	0:05				

STORABLE SPACE-BASED OTV

## STORABLE SPACE-BASED OTV PRELAUNCH PROCESSING

This functional flow and corresponding requirements definitions addresses the operations necessary to prepare the Storable SBOTV for payload mating prior to mission launch.



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OTV FRELAUNCH PROCESSING - STORABLE

SEOUENCE			REQUIREMENTS		TFUNC	ICREW SUPPT	SUPPT	MANHOURS	DURS	
NUMBER	I TASK	FACTLITIES		TRING	711	IVA	IEVA	EVA	ITOTAL	REMARKS
2*1	OTV PreLaunch Processing - Storable	SS hangar, (ligting power, signal, propellant umbilicals	Control console, SS computer, software, robotics, MRMS, tools/effectors		4:35- 0:45- 5:35 1:30	1:30			0:45-	
1.2.1	Remove From Storage and Berth (if required)			1 	1:00	0:45			0:45	OTV fleet size would dictate OTV storage hangar irequirements. The following sequence would apply if a storage hangar is required
1.2.1.1	Disconnect power and signal umbilical		Control console, SS computer		0:02					
1.2.1.2	Open storage hangar door		Control console, SS computer		0:05					
1.2.1.3	Translate OTV to processing  hangar		Control console, SS computer	~	0:45	0:45			0:45	
1.2.1.4	Attach power and signal		Control console, SS computer		0:02					

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OTV PRELAUNCH PROCESSING - STORABLE

SEQUENCE			REQUIREMENTS		PUNC	FUNC   CREW SUPPT   MANHOURS	W.	HOURS		
NUMBER	TASK	PACILITIES	T00LS	TRNC	TRNG   TIME	IVA EVA EVA	EVA	TOTAL	REMARKS	
1.2.2	Load Prelaunch Processing		Control console, SS computer, software		0:40 0:20	0:20		0:20		
1.2.2.1	Verify program matchs OTV configuration		Control console, SS computer		0:15 0:15	0:15		0:15		
1.2.2.2	Conduct program self-test		Control console, SS computer		0:20					
1.2.2.3	Verify program self-test		Control console, SS computer		0:05	.   50:0		0:05		
	_	_		_		_	_	_		

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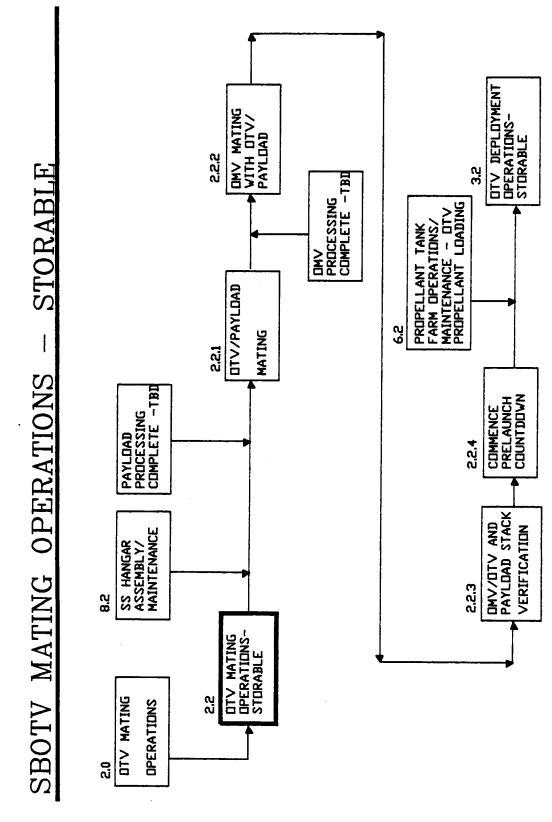
OTV PRELAUNCH PROCESSING - STORABLE

SEQUENCE			REQUIREMENTS	DINC	FUNC TOREW SUPPT		MANHOURS	
NUMBER	i TASK	FACTLITIES	S ITRING		IVA LEVA	EVA	TOTAL	REMARKS
1.2.3	Conduct System/Subsystem Verification - Self Test		Control console, SS computer,   -   3	3:55	0:25		0:25	
1.2.3.1	Load program and conduct automatic test of the following subsys		Control console, SS computer   1   0	0:10 0:10	0:10		0:10	
1.2.3.2	Avionics		Control console, SS computer   1	00:				
1.2.3.3	GN&C		Control console, SS computer   1   0	0:30				
1.2.3.4	Data management		Control console, SS computer   1   0	0:30				
1.2.3.5	Communications and tracking   (less RF antenna systems)		Control console, SS computer   1   0	0:30				
1.2.3.6	  Power (less fuel cells)		Control console, SS computer   1   0	0:30				Fuel cells checked following RCS propellant transfer
1.2.3.7	Payload interface system		Control console, SS computer   1   0	0:30				
1.2.3.8	Verify self test		5	0:15 0:15	0:15		0:15	

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# STORABLE SPACE-BASED OTV MATING OPERATIONS

payload and OMV mating and the attendant operations required to checkout and verify the OMV/OTV/payload stack.



					ort	mbly/	La ·			
	REMARKS				See 7.0 Logistics Support	See 8.0 SS Hangar Assembly/ Maintenance	0:15 Assumed to be in hangar			1:00  Correct anomalles
MANHOURS	TOTAL	10:25		1:45	1		0:15	0:15	0:15	1:00
$\vdash$	EVA									
CREW SUPPT	IVA EVA	10:25		1:45	 	   	0:15	0:15	0:15	1:00
FUNC	TIME	15:30		1:45	1		0:15	0:15	0:15	1:00
	TRNC	:				·	~	~	~	~
REQUIREMENTS	TOOLS	Control console, SS computer   RMS, robotics, CCTV software					Control console, SS computer, RMS, CCTV	Control console, SS computer, RMS, CCTV	Control console, SS computer, CCTV	Control console, SS computer,
	FACILITIES	SS hangar, ligting,	signal, propellant					·		
	TASK	OTV and Payload Mating Operations - Storable		OTV/Payload Mating	Logistic support available to support mating operations	Verify hangar contamination level	Translate payload to OTV processing area	Secure payload to mating cradle	Verify OTV/payload alignment	Mate OTV/payload - verify  proper electrical/mechanical  interfaces
SEOUENCE	NUMBER	2.2		2.2.1			2.2.1.1	2.2.1.2	2.2.1.3	2.2.1.4

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- N	TASK OMV Mating with OTV/Payload	FACILITIES	REQUIREMENTS TOOLS	ST	TRNG	FUNC TIME 1:20	CREW SUPPT IVA   EVA   1:15	EVA TOTAL	E REMARKS
inslat cessi	Translate OMV to OTV processing area		Control console, SS computer, RMS, CCTV	SS computer,	~		0:30	 0:30	
ure	Secure OMV to mating cradle		Control console, SS computer, RMS, CCIV	SS computer,	, 70	0:15	0:15	 0:15	
:1fy	Verify OMV/OTV alignment		Control console, SS computer, RMS, CCTV	SS computer,	7	0:15	0:15	 0:15	
e OM	Mate OMV/OTV - verify proper mechanical interfaces		Control console, SS computer, CCIV,	SS computer,	7	0:15	0:15	 	0:15   Correct anomalies
nect illc	Connect power, signal, umbilicals to OMV		Control console, SS computer,	SS computer,		0:05		 	

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SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	I MA	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TRNG TIME	IVA EVA	EVA	TOTAL	REMARKS
2.2.3	OMV/OTV/Payload Stack Verification			1	0:30	0:30		0:30	
2.2.3.1	Verify mechanical/electrical connections		Control console, SS computer, CCTV		0:20   0:20	0:20		0:20	
2.2.3.2	Verify stack is ready to commence prelaunch countdown		Control console, SS computer	- 	0:10   0:10	0:10		0:10	

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SEQUENCE		L	REQUIREMENTS		FUNC	FUNC CREW SUPPT   MANHOURS	MANHOURS	
NUMBER	TASK	PACILITIES	TOOLS	TRNC	TRNG [TIME	IVA IEVA	EVA   TOTAL	REMARKS
2.2.4	Prelaunch Countdown			<u> </u>	11:40	6:55	6:55	
2.2.4.1	Propellant Transfer		Control console, SS computer, leak detection equipment	1	4:25	4:05	4:05	See 6.0 Propellant Tank   Farm Operations/Maintenance
2.2.4.1.1	Attach propellant umbilicals		Control console, SS computer	- 	0:20	<b></b> -		· .
2.2.4.1.2	Verify detection equipment operational		Control console, SS computer	- 	0:02	0:02	0:0	
2.2.4.1.3	Complete propellant transfer		  Control console, SS computer  leak detection equipment		4:00	100:4	4:00	Monitor for leaks

OTV MATING OPERATIONS-STORABLE

SHEET 5 of 12

SEQUENCE			REQUIREMENTS		FUNC	FUNC   CREW SUPPT   MANHOURS	MANIE	DURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	IVA EVA	EVA	TOTAL	REMARKS
2.2.4.2	Conduct Avionics Module Testings			1	1:00	0:30		0:30	
2.2.4.2.1	  Verify OTV configuration		Control console, SS computer		0:15	0:15		0:15	
2.2.4.2.2	Select, verify and load diagnostic checkout program		Control console, SS computer		0:15	0:15		0:15	
2.2.4.2.3	Conduct diagnostic testing  of avionics systems (less  RF antennas)		Control console, SS computer		0:30			Cori	Correct anomalies - See 4.0 for maintenance activities

OTV MATING OPERATIONS-STORABLE

SHEET 6 of 12

SEQUENCE			REQUIREMENTS		FUNC	CREW SI	JPPT	FUNC   CREW SUPPT   MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TRING TIME IVA	IVA	EVA	EVA TOTAL	REMARKS
2.2.4.3	Conduct Power Checks			   	0:35	0:05		0:05	
2.2.4.3.1	Verify fuel cell propellant		Control console, SS computer		0:15				
2.2.4.3.2	Verify fuel cell operation		Control console, SS computer		0:15				
2.2.4.3.3	Verify self-test			7	0:05	0:05		0:02	
		-		•	•	•	•		

SHEET 7 of 12

	TASK	Load Mission Program	0	Verify wission program prior  to loading	Load program, conduct program verification	  Verify program test
				gram prior	luct	
	PACILITIES					
REQUIREMENTS	TOOLS			Control console, SS computer	Control console, SS computer	
	TRM: TIME		    -			
FINC	TIME		1:30	0:20	1:00	0:10
MING COPE CHOPE	TUA LEVA	EAU	0:30	0:20		0:10
Silvary a	NAC YAN	649	!			
9.0	<u>_</u>	TOTAL	0:30	0:20		 

### SHEET 8 of 12

OTV MATING OPERATIONS-STORABLE

SEQUENCE			REQUIREMENTS		FUNC	FUNC CREW SUPPT 1 HANHOURS	MAN	TOURS	
MOTOREA	TASK	FACILITIES	TOOLS	TRING	TRNG TIME	IVA LEVA LEVA LTOTAL	EVA	TOTAL.	PEMARKS
2.2.4.5	Main Engine Check				1:15	0:25		0:25	
2.2.4.5.1	Load self-test program				0:10	0:10		9:30	
2.2.4.5.2	Engine valve operation check		  Control console, SS computer	2	0:15			3	
2.2.4.5.3	Instrumentation checkout	_ <u>_</u> _	Control console, SS computer	- 7	0:20				
2.2.4.5.4	Solenoid checkout	_ <u>_</u> _	Control console, SS computer	7	0:15	· <b>-</b> -			
2.2.4.5.5	Verify self-tast			~	0:15	0:15		0:15	0:15   Correct anomalies - See 4.0
		•		_	-	_			for maintenance activites

SHEET 9 of 12

	REMARKS		0:05   Correct anomalies	Correct anomalies - See 4.0 for maintenance activities
MANHOURS	TOTAL	0:20	0:02	0:15
MAN	EVA			
FUNC CREW SUPPT	TRNG TIME IVA EVA EVA	0:20	0:05	0:15
FUNC	LIME	0:20	0:05	0:15
	TRNG			~ ~ ~ ~
REQUIREMENTS			Control console, SS computer leak detection equipment	Control console, SS computer
	PACILITIES			
	TASK	Propellant System Check	Verify leak check equipment operational	Verify propellant subsystems operating within limits
SPOIIENCE	MIMBER	2.2.4.6	2.2.4.6.1	2.2.4.6.2

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	REMARKS		0:15  Correct anomalies - See 4.0   for maintenance activities	0:15   Correct anomalles - See 4.0   for maintenance activities
HOURS	TRNG TIME IVA EVA EVA TOTAL	0:30	0:15	0:15
FUNC   CREW SUPPT   MANHOURS	EVA			
SUPPL	EVA			
CREW	IVA	0:30 0:30	0:15   0:15	0:15   0:15
FUNC	TIME	0:30	0:15	0:15
	TRNC		~	~
REQUIREMENTS	TOOLS		Control console, SS computer	Control console, SS computer
	FACILITIES			
	TASK	OTV RCS Check	Conduct RCS system check	Verify RCS propellant loaded within limits
SEQUENCE	NUMBER	2.2.4.7	2.2.4.7.1	2.2.4.7.2

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SEQUENCE			REOUIREMENTS		FUNC	CREW SUPPT	MANHOURS	URS	
NUMBER	TASK	FACILITIES		TRING		IVA   EVA	EVA	TOTAL	REMARKS
2.2.4.8	Verify Health and Status of Payload				1:05	0:15	'	0:15	
2.2.4.8.1	Reverify electrical/ mechanical OTV payload interface		Control console, SS computer, CCTV	~	0:15			· <del></del>	
2.2.4.8.2	Verify proper power levels and telemetry data		Control console, SS computer	~ 	0:20				
2.2.4.8.3	   Verify payload ACS operation   / propellant load		Control console, SS computer	~~~	0:15				·
2.2.4.8.4	Verify self-test			~	0:15	0:15		0:15   Correct   payload  activit	0:15   Correct anomalies - See   payload maintenance   activities - IBD

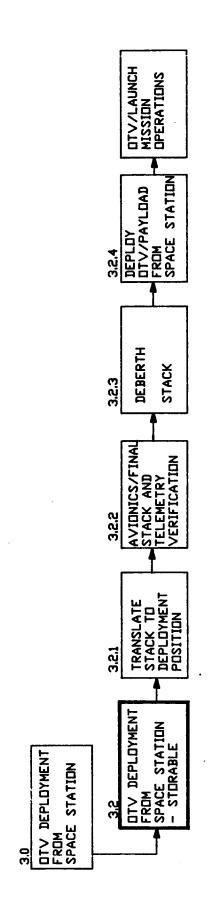
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	REMARKS					0:15   Correct anomalies - See OMV   maintenance activites - TBD
JURS	TOTAL	0:15				0:15   Col
MANHOURS	EVA 17	'				
FUNC CREW SUPPT	IVA EVA EVA					
CREW	IVA	0:15	·			0:15
FUNC	TIME	1:0	0:10	0:20	0:15	0:15
	TRNC		8	7	7	~
REQUIREMENTS	TOOLS		Control console, SS computer	Control console, SS computer	Control console, SS computer	
	FACILITIES					
	TASK	Verify Health and Status of OMV	Reverify mechanical OMV/OTV	Verify proper power levels and telemetry data	Verify propellant load	Verify self-test
SEQUENCE	NUMBER	2.2.4.9	2.2.4.9.1	2.2.4.9.2	2.2.4.9.3	2.2.4.9.4

## STORABLE SPACE-BASED OTV DEPLOYMENT

A functional flow and requirements definition set relative to deployment of the Storable SBOTV, mated with a payload and the OMV, from Space Station is provided.



OTV DEPLOYMENT - STORABLE

SHEET 1 of 4

TASK	FAC	FACILITIES	REQUIREMENTS FUNC TOOLS TRNC TIME		CREW SUPPT	MANHOURS EVA TOTA	HOURS
OTV Deployment From Space SS hangar, Control console, SS computer, Station - Storable 11ghting, CCTV, RMS power signal, propellant umbilicals	SS hangar, Control co lighting, CCTV, RMS power algnal, propellant	Control co		2:40	1:25		1:25
Translate Stack to Deployment Position				1:15	0:30		0:30
Verify mating/checkout	Control con	Control con	Control console, SS computer   2   0:20	50	<del></del>		
Release propellant	Control con	Control con	Control console, SS computer   1   0::	0:20			
Open hangar doors   Control con	CCIV	Control con	Control console, SS computer   1   0:0	0:05			
Translate stack to hangar   Control corporch		Control con	Control console, SS computer   2   0:	0:30	0:30		0:30

SHEET 2 of 4

OTV DEPLOYMENT - STORABLE

			4.0 es	4.0 es
	REMARKS		0:10   Correct anomolies - See 4.0   for maintenance activities	0:10   Correct anomolies - See 4.0   for maintenance activities
HOURS	TOTAL	0:20	0:10	0:10
HAN	EVA			
PUNC CREM SUPPT   MANHOURS	TRNG TIME IVA EVA EVA TOTAL	0:20	0:10	0:10
PUNC	TIME	0:20	0:10	0:10 0:10
	TRNC			
REOUTREMENTS	L		Control console, SS computer, antenna systems	Control console, SS computer, antenna systems
	PACTITIES			· 
	TASK	Avionics/Final Stack and Telemetry Verification	Conduct S-Band check	Conduct GPS check
SECUENCE	NIMBER	3.2.2	3.2.2.1	3.2.2.2

OTV DEPLOYMENT - STORABLE

SHEET 3 of 4

SEQUENCE			REQUIREMENTS		_		-	H	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS		TRING	TIME	IVA EVA	EVA	TOTAL	REMARKS
3.2.3	Release Deberth Stack					0:35	0:05		0.05	
3.2.3.1	Release latches on OMV		Control console, SS computer,	computet,		0:02			0:05	
3.2.3.2	Collapse OMV mating cradle		Control console, SS computer, CCTV	computer,		0:05			0:02	
3.2.3.3	Release latches on payload		Control console, SS computer,	computer,		0:02	- <del></del>		0:05	
3.2.3.4	Collapse payload mating cradle		Control console, SS computer, CCTV	computer,	-	0:05			0:02	
3.2.3.5	Attach space crane; release latches on OTV and collapse berthing cradle		Control console, SS computer,	computer,	8	0:05			0:02	
3.2.3.6	Release power and signal umbilicals		Control console, SS computer,	computer,		0:02		<del></del>	0:02	
3.2.3.7	Verify sequence complete				- 7	0:05	0:05		0:02	

OTV DEPLOYMENT - STORABLE

SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	UPPT	MANHOURS	OURS I	
NUMBER	TASK	PACILITIES	TOOLS	TRING	TIME	IVA	EVA	EVA	TOTAL	REMARKS
3.2.4	Deploy OMV/OTV/Payload from	· <b>-</b>			0:30	0:30			0:30	
	Space Station							_		
3.2.4.1	Translate OTV and space crane		Control console, SS computer,	~	0:30	0:30		- —	0:30	
					_	_	-	-	. <del>-</del>	
3.2.4.2	Deploy stack	_	Control console, SS computer,	7			_	_	-	
			CCLA						<del></del>	
3.2.4.3	Control of stack transferred	·	-	~	1	1			1	
	LO space station						-			

# STORABLE SPACE-BASED OTV POSTMISSION PROCESSING

The operations associated with retrieval of the Storable SBOTV and OMV, with or without a return payload, and the safing, demating, detanking, and maintenance operations necessary after the return from a mission are provided in the following charts.

LDGISTICS SUPPORT

7.2

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### MARTIN MARIETTA

#### Assumptions:

- All major components will be removed as a unit i.e., Fuel Tanks, Regulators, Avionics Modules, Engine(s).
- Only items that cannot be replaced on orbit will be located within the Main Structure.
- Tool Kits, special tools and robotic effectors will be provided for each major task.
- Removal of the main propulsion engine(s) will not require removal of the aerobrake.
- Robotics will be capable of reaching all connect/disconnect points on the vehicle.
- Robotics will be used to the maximum extent possible to preclude EVA operations except in contingencies.

## Common Actions Associated With All Functions

- . Verify OTV berthing and latching prior to any activities.
- Verify OTV propellant levels and safing.
- . Verify operation of remote manipulator systems and robotics.
- 4. Verify current maintenance procedures and robotic programs are available and loaded.
- . Verify that tools/effectors are available and serviceable.
- Verify that all required test equipment is on hand and operational. Computer programs are available.
- SS hangar will be clear of all packaging debris after every maintenance activity Disposal bags will be required during all maintenance activities.

OTV POSTMISSION PROCESSING - STORABLE

SHEET 2 of 46

MANHOURS	EVA TOTAL REMARKS	1	2:00			0:15	0:20	0:30	0:02	0:20	0:03	10.25
CREW SUPPT		1	2:00			0:15	0:20	0:30	0:02	0:20	0:05	0:25
FUNC	TRNG TIME	1	2:10	1 0:05	1   0:15	2   0:15	2   0:20	2   0:30	2 0:05	2   0:20	2   0:05	2   0:30
REOUIREMENTS	S	SS hanger, Control console, SS computer, lighting,  CCTV, robotics, tools/power   effectors,   effectors,   propellant		Control console, SS computer	Control console, SS computer	Control console, SS computer	Control console, SS computer, CCTV, MRMS	Control console, SS computer,	Control console, SS computer,	Control console, SS computer	Control console, SS computer	Control console. SS computer
	TASK FACT	OTV Postmission Processing SS hang Storable power power proper signal, propelly propelly umbilicum cradle, MRMS	Berth OTV in Space Station Hangar	Open hangar doors	Translate OTV berthing structure onto hangar porch	Position MRMS for OTV retrieval	Secure MRMS to OTV grappeling fixtures	Translate OTV to berthing cradle	Position OTV in berthing cradle	Release MRMS grapples -	Demate OMV for OTV	Translate OTV into banear
SEQUENCE	NUMBER	4.2	4.2.1	4.2.1.1	4.2.1.2	4.2.1.3	4.2.1.4	4.2.1.5	4.2.1.6	4.2.1.7	4.2.1.8	4.2.1.9

OTV POSTNISSION PROCESSING - STORABLE

SHEET 3 of 46

REMARKS								
REN					As required	See 6.1.3  OfV detanking		
MANIJOURS A FOTAL	3:15-	0:15	51:0	0:45	0:15	2:15		  0:15 
CREW SUPPT								
	5:45- 3:15- 6:30  4:00	5  0:15	5 10:15	0:45 0:45	5 10:15	5  2:15 		0:15 0:15
TIME	5:4	0:15	0:15	0:4	0:15	2:15	2:30	
TRNG							_ <del>-</del>	
REQUIREMENTS TOOLS	  Control console, SS computer,  CCTV, leak detection  equipment	Control console, SS computer,	Control console, SS computer, leak detection equipment	Control console, SS computer	Control console, SS computer	Control console, SS computer, ICCTV	Control console, SS computer	Control console, SS computer
FACILITIES								
TASK	Determine Mission Effects - Telemetry Analysis	Conduct visual inspection of OTV - hazardous conditions	Conduct leak check	Demate/secure payload	Load diagnostic program and verify as-flown condition	Commence detanking of residual propellants	Run diagnostic program on as-flown configuration	Prepare maintenance plan
SEQUENCE NUMBER	4.2.2	4.2.2.1	4.2.2.2	4.2.2.3	4.2.2.4	4.2.2.5	4.2.2.6	4.2.2.7

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OTV POSTMISSION PROCESSING - STORABLE

SHEET 4 of 46

CEUIENCE			REDUIREMENTS		FUNC   CREW SUPPT   MANHOURS	CREW S	UPPT	MANH	JURS	
NUMBER	TASK	FACILITIES	T00LS	TRMG	TRING ITIME	IVA	IEVA II	IEVA T	TOTAL	REMARKS
4.2.3	Complete OTV Safing  Operations				0:40 0:35	0:35		_='	0:35	
4.2.3.1	  Verify propellant valves  closed		Control console, SS computer .	. S	!	1			1.	
4.2.3.2	Conduct leak check		Control console, SS computer, leak check equipment		0:10 0:10	0:10		-=	0:10	
4.2.3.3	Verify tank pressure  stabilized		Control console, SS computer pressure gauges	2	01:0 01:0	0:10		-=	0:10	
4.2.3.4	Ofsconnect propellant		Control console, SS computer	2	0::0					
4.2.3.5	Verify critical electrical  and avionics components  safed		Control console, SS computer		51:00	51:0		.=	0:15	

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OTV POSTMISSION PROCESSING - STORABLE

SHEET 5 of 46

SEDIENCE			REDUTREMENTS			FUNC	ICREW SUPPT	-	MANHOURS	
NUMBER	TASK	FACILITIES	1001.5	S	TRMG	3	IVA LEVA	A IEVA	TOTAL	REMARKS
4.2.4	Perform Scheduled  Waintenance				<del>-</del>			- <del>-</del>	<del></del>	
4.2.4.1	Propellant Tank Scheduled NaIntenance	SS hangar lighting, power, signal, propellant	SS computer, control console, test equipment, robotics, CCTV, tools/effectors	obotics, tors		2:15	1:55		1:55	Computer interfaces with onboard diagnostic equipment/systems o Includes an external visual inspection (CCTV)
4.2.4.1.1	  Translate robotics to tool  area and secure tools/  effectors		Control console, SS computer,	SS computer,		0:05				
4.2.4.1.2			Control console, SS computer	SS computer		0:05				
4.2.4.1.3	Visually inspect propellant tank and valve system		Control console, CCTV, robotics	ccTV,	~	1:40	1:40		1:40	
4.2.4.1.4	  Conduct diagnostic testing		Control console, SS computer	SS computer	· <b>,</b>	0:15	0:15		0:15	Mon-destructive test  equipment
4.2.4.1.5	  Translate robotics to tool  area store tools/effectors		Control console, SS computer, CCTV	SS computer,		0:05				
4.2.4.1.6	Translate robotics to storage .		Control console, SS computer	SS computer	-	0:02				
	-	•								

OTV POSTMISSION PROCESSING - STORABLE

SHEET: 6 of 46

SEQUENCE			REQUIREMENTS		FUNC	FUNC   CREW SUPPT	SUPPT	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	IVA	EVA	EVA 1	TOTAL REMARKS
4.2.4.2	Avionics Scheduled Maint.							_	
4.2.4.2.1	Module Test	SS Hangar, 11ghting, power,	SS Hangar, Control console, SS computer, 11ghting, itest equipment power.		2:05	0:30			0:30
		signal, propellant umbilicals							
4.2.4.2.1.1	Verify signal and power umbilicals connected		Control console, SS computer	- <del></del> -	0:10			<del></del>	
4.2.4.2.1.2	Verify required test software is loaded into SS computer		SS computer, control console		0:15	0:15			0:15
4.2.4.2.1.3	Conduct test		SS computer, control console		11:25				Replace defective modules.
4.2.4.2.1.4	  Verify self-test complete		SS computer, control console	le   2	0:15	0:15		<del></del>	0:15

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OTV POSTMISSION PROCESSING - STORABLE

								200	200	200		
SEQUENCE NUMBER	TASK	FACILITIES	KEUUI KEMENIS TOOLS		TRNG	TIME	IVA TEVA		EVA TOTA	TOTAL	REMARKS	
4.2.4.2.2	Scheduled Module Replacement	SS hangar, lighting, power, signal, propellant	Control console, ICCTV, robotics, i ment, tools/effe	SS computer, Lest equip- tors, LRU's		1:50	1:00			00:1		
4.2.4.2.2.1	Translate robotics to tool area and secure tools/ sffectors		Control console, S  robotics, CCTV	SS computer,		0:05						
4.2.4.2.2.2	Translate robotics to spare parts storage area - secure replacement module and store		Control console, SS computer,  robotics, CCTV	S computer,		0:05						
4.2.4.2.2.3	Translate robotics to work		Control console, SS computer	S computer		0:05						
4.2.4.2.2.4	Remove avionics module and store	- جيه حد حد ح	Control console, SS co  robotics, CCTV, tools/  effectors	SS computer,   tools/	2	0:15	0:15			0:15		
4.2.4.2.2.5	Visually inspect module  mounting interface for  defects		Control console, S  CCTV, robotics,	SS computer,	8	0:05	0:05			0:02		
4.2.4.2.2.6	Install replacement module and secure		[Control console, SS computer, ICCTV, robotics, tools/ effectors	SS computer,   ools/	8	0:15	0:15			0:15		
4.2.4.2.2.7	Conduct module test/  checkout		Control console, SS computer	S computer		0:30	0:02			0:02		
4.2.4.2.2.8	Translate robotics to parts storage area-package module for shipment		Control console, S  robotics, CCTV	SS computer,		0:50	0:20			0:20	Return to earth	
4.2.4.2.2.9	Translate robotics to tool storage and secure tools		Control console, S  robotics, CCTV	SS computer,		0:05						
4.2.4.2.2.10	Translate robotics to Istorage and secure		Control console, SS computer	SS computer		0:05						

OTV POSTMISSION PROCESSING - STORABLE

SHEET 8 of 46

			REQUIREMENTS			- 1 - 1	CREW SUPPT	TAAN		URS	
	TASK	FACILITIES	TOOLS		TRNC TIME	TIME	IVA EVA		EVA  T	TOTAL	REMARKS
ACS Update		SS Hangar, Control of lighting, software signal, power, propellant umbilicals	Hangar, Control console, SS computer, hting, software nai, er, pellant	computer,		0:45	0:10			0:10	
Verify umbili	Verify power and signal umbilicals are connected		Control console, SS computer	computer		0:05					
Verify	Verify ACS update loaded ·	- <del></del> -	Control console, SS computer,  software	computer,		10:03	0:02			0:05	
Update ACS	· AGS		Control console, SS computer, software	computer,	7	0:30					
Verify	Verify update complete		Control console, SS computer	computer	~	0:05	10:05			0:05	
		•		•	•		-	•	-	•	

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OTY POSTMISSION PROCESSING - STORABLE

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OTV POSTMISSION PROCESSING - STORABLE

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	REMARKS					Correct anomalies	·
MANHOURS	TOTAL		0:35		0:02	0:30	
L	EVA						
CREW SUPPT	EVA		·				
CREW	IVA		0:50		0:05 0:05	0:30 0:30	
FUNC	TIME		0:50	0:10	0:05	0:30	0:02
	TRNC			8	7		~
REQUIREMENTS	TOOLS		SS hangar, Control console, SS computer, Ilghting, CCTV, test equipment, RMS power, signal, propellant wabilicals		Control console, SS computer	Control console, SS computer	Control console, SS computer
	FACILITIES		SS hangar, lighting, power, signal, propellant				
	TASK	RCS Scheduled Maintenance	Leak Check	Condition propellant umbilical	Connect umbilical and verify connection	Conduct leak check and verify	Disconnect propellant umbilical
SEQUENCE	NUMBER	4.2.4.3	4.2.4.3.1	4.2.4.3.1.1	4.2.4.3.1.2	4.2.4.3.1.3	4.2.4.3.1.4

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OTV POSTMISSION PROCESSING - STORABLE

SECUENCE			REQUIREMENTS		FUNC	CREW SUPPT	UPPT	MANHOURS	
NOMBER	TASK	FACILITIES	TOOLS	TRING	TIME	IVA	EVA IE	EVA TOTAL	REMARKS
4.7.4.3.9	The state of the s						-	- 3	
	1 trailsaucer check	135 hanger,	langer,   Control console, 55 computer,	<u>.</u>	3	8:5		0:50	
	_	power,	DOWER.						
		signal,				_	_	_	
		propellant umbilicals							
				_		_	_	_	_
4.2.4.3.2.1	Verify power, signal and		Control console, SS computer	-	0:02				
	connected								
4.2.4.3.2.2	Took transfer to the desired				9170			71.0	
	Boftware .		Control console, 55 computer,   Boftware	- -	CT:0 —			-	
		_			_	_			
4.2.4.3.2.3	Conduct transducer check		SS computer, software		0:30				-
4.2.4.3.2.4	  Verify check complete		  Ss computer.control connole	~	0:05 10:05	0:05		- 0:02	-
	•	•			}	-	•	))))	_

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SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	MANHOURS		
NUMBER	TASK	FACILITIES	T00LS	TRNC TIME	TIME	IVA EVA	EVA	TOTAL REM	REMARKS
4.2.4.3.3	RCS - Resupply	SS hanger, lighting, power, signal, propellant	SS hanger, Control Console, SS computer, lighting, RCS software power, signal, propellant		1:50	1:35		1:35	
4.2.4.3.3.1	Condition propellant  umbilical		Control console, SS computer	8	0:10			<del></del>	
4.2.4.3.3.2	Connect propellant umbilical and verify connection	~	Control console, SS computer, RMS		0:05	0:02		0:03	
4.2.4.3.3.3	Transfer RCS propellant		Control console, SS computer, leak detection equipment	8	1:15	1:15   1:15		1:15  Monitor for leaks	aka
4.2.4.3.3.4	Blow back propellant umbilical when transfer complete	·	Control console, SS computer	8	0:15	0:15   0:15		0:15	
4.2.4.3.3.5	Disconnect propellant umbilical		Control console, SS computer, RMS	~	0:05				

SECHENCE					FUNC	ICREW SUPPT	L	MANHOURS	
NUMBER	TASK	FACTLITIES		TRNG	1 1	IVA IEV	A EVA	TOTAL	REMARKS
4.2.4.3.4	RCS - Health Maintenance								
4.2.4.3.4.1	Scheduled Transducer Replacement	SS hanger, I lighting, Ir power, Is signal, propellant	nger, Control console, SS computer, Ing, Irobotics, CCTV, tools/ effectors		2:20	1:30		1:30	
4.2.4.3.4.1.1	Translate robotics to tool storage area and secure tools/effectors		Control console, SS computer, robotics, CCTV		0:02				
4.2.4.3.4.1.2	Translate robotics to parts storage area select LRU and store	,	Control console, SS computer, robotics, CCTV		0:02		· — — — —		
4.2.4.3.4.1.3	Translate robotics to work site		Control console, SS computer		0:05			. — — —	
4.2.4.3.4.1.4	Remove transducer and store		Control console, SS computer, robotics, CCTV, tools/	~ .	0:30	0:30		0:30	
4.2.4.3.4.1.5	Conduct visual inspection		Control console, SS computer, CCTV	8	0:05	0:02		0:02	
4.2.4.3.4.1.6	Install and secure  replacement transducer		Control console, SS computer, robotics, CCTV, tools/	8	0:30	0:30		0:30	
4.2.4.3.4.1.7	Conduct transducer check   and verify	· 	SS computer, software		0:30	0:05		0:02	
4.2.4.3.4.1.8	Translate robotics to parts  storage area - package for  shipment		Control console, SS computer, robotics, CCTV		0:20	0:20	. <b></b> -	0:20	Return to earth
4.2.4.3.4.1.9	Translate robotics to tools storage area, secure tools		Control console, SS computer, robotics, CCTV		0:02				
4,2,4,3,4,1,10	Translate robotics to  storage area and secure		Control console, SS computer		0:02				

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MARTIN MARIETTA Return to earth 0:50 0:15 0:30 0:10 0:15 0:30 0:50 I MANHOURS |EVA | TOTAL 2:20 ICREW SUPPT 10:15 10:20 0:30 0::0 10:15 0:50 0:30 2:20 0:15 0:50 0:15 0:50 0:05 0:05 0:02 0:30 0:15 0:05 2:55 0:05 0:05 TRNG TIME 8 Control console, SS computer, robotics, CCTV, tool/effectors Control console, SS computer, robotics, CCTV Control console, SS computer, CCTV Control console, SS computer, robotics, CCTV SS hanger, Control console, SS computer, lighting, LRU's, robotics, CCTV, tools/ Control console, SS computer Control console, SS computer leak detection equipment Control console, SS computer Control console, SS computer A - 215REQUIREMENTS effectors | power, | e | signal, | propellant| FACILITIES Connect thruster propellant lines and electrical interfaces Translate robotics to parts area - package thrusters for shipment Translate robotics to spare parts storage area - secure spare thrusters and store Translate robotics to tool Translate robotics to tool storage area and secure tools/effectors Remove and store thruster storage area and secure Translate robotics to Translate robotics to work site propellant lines and electrical interfaces Blow back propellant lines and disconnect Install new thruster Disconnect thruster Connect propellant umbilical area, secure tools Conduct leak check Scheduled Thruster Replacement TASK 4.2.4.3.4.2.10 4.2.4.3.4.2.12 4.2.4.3.4.2.13 4.2.4.3.4.2.11 4.2.4.3.4.2.9 4.2.4.3.4.2.5 4.2.4.3.4.2.6 4.2.4.3.4.2.8 4.2.4.3.4.2.3 4.2.4.3.4.2.4 4.2.4.3.4.2.7 4.2.4.3.4.2.1 4.2.4.3.4.2.2 4.2.4.3.4.2 SEQUENCE Number

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OTV POSTMISSION PROCESSING - STORABLE

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	REMARKS							*		•		alysis				
	REM						<u>.</u>					Flight data analysis				
MANHOURS	TOTAL	0:40		: 	0:10							- <del></del> -				0:30
	EVA						. <u> —                                   </u>				. —					
CREW SUPPT	IVA TEVA	0:40		 ¦	0::0											30
FURC IC	TIME II	3:55		 !	0:0 0:0	0:30	0:30	0:35	0:10	0:10	0:10	0:10	0:30	0:50	0:10	0:30 10:30
	TRMG			 				~				2				
REOUTREMENTS		SS hanger, Control console, SS computer, lighting, robotics, CCTV Ground computer, power, signal, propellant umbilicals		SS computer, ground computer	Control console, SS computer	SS computer, engine software	SS computer, engine software	SS computer, CCTV robotics	  SS computer, software, CCTV	SS computer, software, CCTV	Control console, SS computer, CCTV	SS computer, software	SS computer, software	SS computer, software	  Control console, SS computer	
	FACTLITIES	SS hanger, ( lighting, in Ground computer, power, signal, propellant							•							
	TASK	Maintenance	Post Flight Maintenance	Analysis of flight data	Load self-test program	Lock up pressure decay	Engine valve operation check	Nozzle inspection	Nozzle extension check	Gimbal actuator check	Connect umbilicals	Turbopump torque check	Instrumentation checkout	Solenoid checkout	Disconnect umbilicals	The state of the s
CENIIEWE	NUMBER	4.2.4.4	4.2.4.4.1	4.2.4.4.1.1	4.2.4.4.1.2	4.2.4.4.1.3	4.2.4.4.1.4	4.2.4.4.1.5	4.2.4.4.1.6	4.2.4.4.1.7	4.2.4.4.1.8	4.2.4.4.1.9	4.2.4.4.1.10	4.2.4.4.1.11	4.2.4.4.1.12	21 1 1 2 7

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OTV POSTMISSION PROCESSING - STORABLE

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0.7047.10	KEMAKKS									
	A TOTAL	1:30				0:30	1:00			
	EVA EVA									
	IVA	1:30				0:30	 8: 			
	TIME	5:00	0:02	0:02	0:02	0:30	 	0:02	0:02	0:02
	TRNG						~			
REQUIREMENTS	T00LS	SS hanger, Control console, SS computer lighting, boroscope, robotics, LRU, power, tools/effectors signal, propellant	Control console, SS computer, RMS, robotics, CCTV	Control console, SS computer, robotics, CCTV	Control console, SS computer	Control console, SS computer, robotics, CCTV, boroscope	Control console, SS computer, ICTY, RNS	Control console, SS computer, Irobotics, CCTV	Control console, SS computer, Irobotics, CCTV	Control console, SS computer
	FACILITIES	SS hanger,   C   I ighting,   b   power,   t   signal,   propellant   umbilicals								· 
	TASK	Engine - Periodic Maint	Translate robotics to tool storage area - secure tools/effectors			Conduct engine boroscope  inspection.	  Conduct thrust chamber  Inspection	Translate robotics to parts   storage area. Secure unused   parts	Translate robotics to tool   storage area - secure  tools/effectors	  Translate robotics to  storage area and secure 
כבעוובתעב	NUMBER	4.2.4.4.2	4.2.4.4.2.1	4.2.4.4.2.2	4.2.4.4.2.3	4.2.4.4.2.4	4.2.4.4.2.5	4.2.4.4.2.6	4.2.4.4.2.7	4.2.4.4.2.8

OTV POSTMISSION PROCESSING - STORABLE

CENTIFIER			REDITREMENTS		1	ICREW SUPPT	HPPT	MANHOURS	URS	
NUMBER	TASK	FACILITIES	T00LS	TRNG	TIME	IVA	1 1	IEVA II	I TOTAL	REMARKS
4.2.4.4.3	d Replace	ISS hanger, Control lighting, robotics power, effecton signal, protecti propellant	Control console, SS computer, robotics, RMS, CCTV, tools/ effectors, special tools, protective covers		5.30	3:35			3:35	
4.2.4.4.3.1	Translate robotics to tool  storage area - secure  tools/effectors		Control console, SS computer, Irobotics, CCTV		0:05		 ·			
4.2.4.4.3.2	Translate robotics to parts   storage - secure and store   parts		Control console, SS computer, irobotics, CCTV		0:05					
4.2.4.4.3.3	Translate robotics to work site		Control console, SS computer		0:05					
4.2.4.4.3.4	Using the engine removal tool, disconnect engine from interface plate		Control console, SS computer, robotics, CCTV, special tool	~	0:40	0.40			0:40	
4.2.4.4.3.5	Inflate engine removal tool	ی کاری میٹی ک	Control console, SS computer, robotics, CCTV	~	0:02	0:02			0:02	
4.2.4.4.3.6	Remove engine with robotics		Control console, SS computer, CCTV, robotics, special tool	2	0:05	0:02			90:02	
4.2.4.4.3.7	Translate RMS to work site; Attach grapple; disengage removal tool		Control console, SS computer, robotics, RMS, CCTV,	8	0:10	0::0			0:10	
4.2.4.4.3.8	Translate RMS to parts storage area and secure unserviceable engine		Control console, SS computer, RMS, CCTV,	~	0:15	51:0			0:15	
4.2.4.4.3.9	Translate robotics to parts storage area; unpackage replacement engine		Control console, 'SS computer, robotics, CCTV,	2	0:15	0:15			0:15	
4.2.4.4.3.10	  Conduct visual inspection		CCTV, robotics	2	0:05	0:05			0:02	
4.2.4.4.3.11	Attach RMS to engine  grapple; translate RMS  to work site		Control console, SS computer, CCTV, robotics	8	0:15	0:15			0:15	
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OTV POSTMISSION PROCESSING - STORABLE

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4					ĺ	-1	TAKE ALIANS	- L	MINISTER	
SEQUENCE	TASK	FACILITIES	TOOLS		TRNG	TIME	IVA IE	, ,	EVA TOTAL	AL REMARKS
4.2.4.4.3.12	Translate robotics to Work site; secure removal tool		Control console, SS computer	SS computer	 . <b>_</b>	0:05				
4.2.4.4.3.13	Install engine removal tool; inflate support mechanism	,	Control console, SS computer, robotics, CCTV, special tool	SS computer,   becial tool	~~~	0:10	0:10		0:0	9
4.2.4.4.3.14	Position robotics for installation		Control console, S	SS computer	~~~	0:05				
4.2.4.4.3.15	Release RMS from engine  grapple		Control console, S	SS computer,	2	,				
4.2.4.4.3.16	Verify engine alignment with interface		Control console, SS computer, robotics, CCTV, special tool	SS computer,   secial tool	~	90:0	0:02		0:02	
4.2.4.4.3.17	Complete installation verify locking mechanisms are secured		Control console, SS computer,  robotics, CCTV, special tool	SS computer, l	~	0:40	0:40		0:40	
4.2.4.4.3.18	Disengage engine removal tool		Control console, S Irobotics, CCTV	SS computer,	2	0:02	0:02		0:02	90
4.2.4.4.3.19	Engine check and verify		Control console, SS computer,	SS computer,	~	1:30	0:50		. <del>.</del>	0:20
4.2.4.4.3.20	Translate RMS to parts Istorage area and secure Unserviceable engine at Igrapple fixture		Control console, SS computer, RMS, CCTV	SS computer,	~	0:05	0:02	- <b></b>	0:02	
4.2.4.4.3.21	Translate robotics to tool storage area and secure engine removal tool		Control console, SS computer, robotics, CCTV	SS computer,		0:05				
4.2.4.4.3.22	Translate robotics to parts storage area. Install protective covers on unserviceable engine; prepare for shipment		Control console, SS computer, robotics, CCTV	SS computer,		0:20	0:20			0:20 Return to earth
4.2.4.4.3.23	Store and secure engine with RMS following protective cover installation		Control console, SS computer, robotics, CCTV, protective covers	SS computer, rotective	~	0:05	0:05			0:05
4.2.4.4.3.24	Store and secure RMS		Control console,	SS computer   A-219		0:02				Accomplished in conjunction  with 4.1.4.4.3.25

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SEOVENCE			REQUIREMENTS		FUNC	CREW S	UPPT	FUNC ICREW SUPPT   MANHOURS	
	i TASK	FACTLITIES	1001.5	TRNG	11 ME	TIME IVA EVA EVA	EVA	EVA TOTAL	KEMAKKS
4.2.4.4.3.25	Store and secure additional ireplacement parts carried by robotics		Control console, SS computer, robotics, CCTV		0:10				
4.2.4.4.3.26	Translate robotics to tool storage area and secure tools/effectors		Control console, SS computer, robotics, CCTV		0:05				
4.2.4.4.3.27	Translate robotics to storage area and secure		Control console, SS computer		0:02				·

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REMARKS						Correct anomalies		
MANHOURS   A   TOTAL	0:30	0:50				0:10		
CREW SUPP	0:30	0:20				0:10		
TIME	<u></u>	0:50	0:02	0:02	0:50	0::0  01:0	0:05	0:02
TRNG	1	~				~		
REQUIREMENTS 1 TOOLS	SS hanger, Control console, SS computer, lighting, Irobotics, CCTV, special power, equipment signal, propellant	  SS computer, software	SS computer, software,  robotics, CCTV	SS computer, software	Control console, SS computer,  Inspection equipment, CCTV,  robotics	Control console, SS computer	Control console, SS computer, robotics, CCTV	Control console, SS computer
FACILITIES	SS hanger, 1 ghting, power, signal, propellant	umbilicals						
TASK	Aerobrake Scheduled Maintenance Aerobrake Inspection	Analyze post mission telemetry data	Translate robotics to tool storage area; secure tools/ effectors	Translate robotics to aerobrake work site	  Conduct aerobrake inspection   	  Verify inspection data	  Translate robotics to  tool area-secure tools	  Translate robotics to  storage area and secure
SEQUENCE NUMBER	4.2.4.5.1	4.2.4.5.1.1	4.2.4.5.1.2	4.2.4.5.1.3	4.2.4.5.1.4	4.2.4.5.1.5	4.2.4.5.1.6	4.2.4.5.1.7

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CENTIFIED			DECHINDEMENTS		TELINE	ICRE	CRFU CIPPT	MAN	MANHOURS	
NUMBER	TASK	FACTLITIES		ITRNG		Υ	IEVA	IEVA	ITOTAL	REMARKS
4.2.4.5.2	Remove and Replace Aerobrake and Support	ISS hanger, lighting, power, signal, propellant	SS hanger, Control console, SS computer, lighting, !robotics, RMS, CCTV, tools/power, effectors, special tools signal,  LRU's, leak detection propellant equipment		4:25	3:50			3:50	
4.2.4.5.2.1	Translate RMS to aerobrake Work site and attach to grapple fixture		Control console, SS computer		0:02	0:02			0:02	
4.2.4.5.2.2	Translate robotics to tool area; secure and store required tools/effectors		Control console, SS computer,  robotics, CCTV		0:02					
4.2.4.5.2.3	Translate robotics to parts storage area; secure and store replacement hardware		Control console, SS computer,  robotics, CCTV	er,	0:02					
4.2.4.5.2.4	Translate robotics to aerobrake work site		Control console, SS computer		0:02					
4.2.4.5.2.5	Disconnect RCS propellant/ electrical interfaces		Control console, SS computer, robotics, CCTV	er,	0:50	0:50			0:50	
4.2.4.5.2.6	Disconnect aerobrake and support from support		Control console, SS computer, probotics, CCTV	er,	0:15	0:15		· 	0:15	
4.2.4.5.2.7	Translate RMS and robotics from work site to storage larea; secure unserviceable aerobrake and support		Control console, SS computer,  RMS, CCTV	er. – – – – – – – – – – – – – – – – – – –	0:50	0:50			0:20	
4.2.4.5.2.8	Assemble aerobrake and support with RMS and robotics		Control console, SS computer,  RMS, robotics, CCTV	er	0:30	0:30			0:30	
4.2.4.5.2.9	Translate RMS and robotics to work site with replacement aerobrake and support		Control console, SS computer	er -	0:50	0:50			0:20	•
4.2.4.5.2.10	Inspect aerobrake support  ring and RCS propellant/  interfaces		Control console, SS computer,  robotics, CCTV	er,	0:15	0:15			0:15	
		_	A-222	<del>-</del>		_	È	AM	711	MARTIN MARIETTA

OTV POSTMISSION PROCESSING - STORABLE

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NUMBER	TASK	FACILITIES	TOOLS	TRNG   TIME		IVA	1 [	EVA TOTAL	IT REMARKS	RKS
4.2.4.5.2.11	Align aerobrake and support  with attachments		Control console, SS computer, I robotics, RMS, CCTV	~~~~	0:0 	0:10		0:10		
4.2.4.5.2.12	Attach aerobrake and support to support ring, verify mechanical attachments are secure		Control console, SS computer, SMS, robotics, CCTV	~	0::0	0:10		0:10		
4.2.4.5.2.13	Verify RCS propellant/  electrical interfaces are  seated		Control console, SS computer, robotics, CCTV	~~~~	0:10	0:0		0:10		
4.2.4.5.2.14	Attach RCS test equipment		Control console, SS computer, I robotics, CCTV, test equipment	~	0:15	51:0		0:15		
4.2.4.5.2.15	Pressurize RCS propellant spheres		Control console, SS computer	~	0:05					
4.2.4.5.2.16	Conduct RCS propellant    leak check		Control console, SS computer, leak detector equipment	~	0:15	0:15			· 	
4.2.4.5.2.17	Disconnect test equipment		Control console, SS computer, Cobotics, CCTV		0:15	0:15		0:15		
4.2.4.5.2.18	Depressurize RCS propellant spheres		Control console, SS computer		0:02					
4.2.4.5.2.19	Translate RMS to storage area and secure		Control console, SS computer		0:05					
4.2.4.5.2.20	Translate robotics to parts storage area and secure parts		Control console, SS computer,  robotics, CCTV		0:05					
4.2.4.5.2.21	Disassemble unserviceable  aerobrake; package for  shipment		Control console, SS computer, Irobotics, CCTV, tools/		0:30	0:30			0:30 Return to earth	
4.2.4.5.2.22	Translate robotics to tool storage area and secure tools/effectors		Control console, SS computer,		0:05					
4.2.4.5.2.23	Translate robotics to storage area and secure		Control console, SS computer		0:05				`	

OTV POSTMISSION PROCESSING - STORABLE

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SENIE WE			REGITREMENTS			FINC	ICREM SUPPT	-	MANIFOURS	
NUMBER	TASK	FACILITIES		S	TRNG	11	IVA	뛰	A TOTAL	T REMARKS
4.2.5	Perform unscheduled Maintenance									
4.2.5.1	Propellant Tank Unscheduled Maintenance									
4.2.5.1.1	Remove and Replace Propellant Tank	SS hanger, lighting power, signal, propellant	SS hanger, Control console, SS computer, lighting test equipment, robotics, power, tools/effectors signal, propellant umbilicals	SS computer, lobotics,	,	3:00	2:20			2:20
4.2.5.1.1.1	Translate robotics to tool larea; secure & store tools/effectors		Control console, SS computer,	SS computer,	_	0:02				
4.2.5.1.1.2	Translate robotics to work site		Control console, SS computer	SS computer	_	0:05				
4.2.5.1.1.3	Translate RMS to work site and attach propellant tank grapple fixture		Control console, SS computer, RMS, CCTV	SS computer,	~	0:10	0::0			0:10
4.2.5.1.1.4	Release tank at attaching  Point		Control console, SS computer, robotics, CCTV	SS computer,	~	0:15	0:15		ö 	0:15
4.2.5.1.1.5	Release tank at attaching Point 2		Control console, robotics, CCTV	SS computer,	2	0::0	0:10		ö 	0:10
4.2.5.1.1.6	Translate robotics from  work site		Control console, SS computer	SS computer		;	;			This creates a clear path for the propellant tank when removed by RMS'
4.2.5.1.1.7	Remove tank with RMS		Control console, SS computer,	SS computer, 1		0:02	0:05		- <del>-</del> -	0:05
4.2.5.1.1.8	Translate RMS to parts storage area and secure unserviceable tank		Control console, SS computer,  CCTV, RMS	SS computer,	~	0:20	0:50		ö 	0:20
4.2.5.1.1.9	Inspect tank interfaces with robotics; replace or repair any damaged components prior to tank installation		Control console, SS computer,  CCTV, parts kit (as required)	SS computer, as required)	~	03:20	0:50			0:20
4.2.5.1.1.10	Translate RMS with service-		Control console, SS computer,	SS computer,	2	0:50	0:50		- 0	0:20
	able tank to work site		• KH2	A-224				MA	RT	MARTIN MARIETTA

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פבעונבותב			REGITAENENTS		F	FUNC	ICREM SI	SUPPT	MANHOURS		
NUMBER	TASK	FACTLITIES		2	TRNG	11		EVA EVA	A TOTAL	AL I REMARKS	
4.2.5.1.1.11	Verify sufficient clearance between robotics and RMS with tank		Control console, SS computer	SS computer		!	 !			This is a precaution to elsure tank is not damaged ing the initial alignment incress	precaution to en- is not damaged dur- itial alignment
4.2.5.1.1.12	Position/align tank with  OTV attaching and  Interface points	و خدبته وینی ویک بنی	CCTV, SS computer, control console, RMS, robotics	r, control botics	~	0:30	0:0		ö 	0:10	
4.2.5.1.1.13	Secure tank at attaching Point 2	·	Robotics, control console, SS computer, CCTV	l console,	~	0:10	0::0	. — — -	<u>-</u>	0:10	
4.2.5.1.1.14	Secure tank at attaching  Point		Robotics, control console, SS computer, CCTV	l console,	~	0::0	0::0			0:10	
4.2.5.1.1.15	Release RMS from grapple fixture		Control console, SS computer, RMS	SS computer,	~	;	:				
4.2.5.1.1.16	  Install/checkout & calibrate  leak check equipment		Control console, SS computer, test equipment, CCTV	SS computer,   CCTV	~	0:15	51:0			0:15	
4.2.5.1.1.17	  Pressurize tank		Control console, test equipment	SS computer,	~~~	0:15	- <del></del>				
4.2.5,1,1,18	Depressurize tank if no anomalies are detected; disconnect test equipment		Control console, SS computer, robotics, CCTV	SS computer,	~	0:05	0:05			0:05	
4.2.5.1.1.19	Translate RMS to storage location and secure		Control console,	SS computer		0:05	_ <u></u>				
4.2.5.1.1.20	Translate robotics to parts parts		Control console, SS computer,	SS computer,		0:05		<b>-</b>			
4.2.5.1.1.21	Prepare tank for shipment		Control console,	console, SS computer,		0:10	0:10			0:10 Return to earth	
4.2.5.1.1.22	Translate robotics to  storage area and secure		Control console, SS computer	SS computer		0:05					

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			SEXII YES WITH SERVICE	TELLER		regin clibb	Ŀ	MARINAME	98
SEQUENCE NUMBER	TASK	FACILITIES	TOOLS ITRNG	_		A TEVA	Ē		TOTAL   REMARKS
4.2.5.1.2	Propellant Tank Insulation Repair	SS hangar, lighting, power, signal, propellant	SS hangar, Control console, SS computer, I-lighting, tools/effectors, robotics, power, repair unit, special tools signal, propellant		2:00 11:35	32			:35   
4.2.5.1.2.1	Iranslate robotics to tool area; secure insulation repair kit and tools/ effectors		Control console, SS computer, 1 robotics, CCTV		0:00				:
4.2.5.1.2.2	Translate robotics to work site		Control console, SS computer		0:02				
4.2.5.1.2.3	Verify that insulation damage is within established tolerances		Control console, SS computer,   2 measuring equipment, robotics,   CCTV	- <del>-</del>	0:15	51:0			0:15
4.2.5.1.2.4	Fill or remove damaged area  IAW prescribed procedures		Control console, SS computer, 2 robotics, CCTV, repair kit		0:40	0+:0			0:40
4.2.5.1.2.5	Place removed section in  waste disposal container	·	Control console, SS computer,   2 CCTV, robotics		- <del>-</del>	 }			
4.2.5.1.2.6	Replace section IAN prescribed procedures		Control console, SS computer,   2 CCTV, robotics, repair kit		0:40 	0:40			0:40
4.2.5.1.2.7	Verify proper set up and curing is taking place		CCTV, SS computer robotics,   2 control console,		0:02		<b></b> -		·
4.2.5.1.2.8	Translate robotics to tool    area, store tools/effectors		CCTV, control console,		0:02				
4.2.5.1.2.9	  Translate robotics to  storage area and secure 		Control console, SS computer		0:02				

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TASK Transducer Replacement	FACILITIES SS hangar,	REQUIREMENTS TOOLS Control console, SS computer.	TRNC	FUNC TIME 2:05	CREW SUPPT IVA EVA		KVA TOTAL 1:15	REMARKS
a t	lighting, power, signal propellant	Control Console, 35 [CCTV, robotics, LRU, [tools/effectors, tes equipment						
Translate robotics to tool area - secure tools/ effectors and test equipment	· — — —	Control console, SS computer,  robotics, CCTV	i, 	0:02				
Translate robotics to parts storage area and secure replacement transducer		Control console, SS computer,  robotics, CCTV		0:0				
Translate robotics to work site		Control console, SS computer	- <del>-</del>	0:02				
		Control console, SS computer, robotics, CCTV, tools/ effectors	IF,	0:20	0:20		0:50	
		Control console, SS computer, tobotics, CCTV, tools/effectors	, 2	0:50	0:20		0:50	
	Install/checkout & calibrate transducer test equipment	Control console, SS computer, CCTV, robotics, test	r,	0:15	0:15		0:15	
	Conduct transducer checkout	Control console, SS computer, CCTV, robotics,	ř. 	0:15		. — — -		Correct anomolies
	<del></del>	Control console, SS computer, CCTV, robotics,	r,	0:15	0:15		0:15	
Translate robotics to parts area; package unserviceable transducer		Control console, SS computer, [CCIV, robotics,	<u> </u>	0:15	0:15		0:15	Return to earth
Translate robotics to tool area - secure tools and test equipment		Control console, SS computer, robotics, CCTV		0:02				
		Control console, SS computer	- <del></del>	0:02				
		I A-227			-	MA	RTIN	ARTIN MARIETTA

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CENTIFUE			REQUIREMENTS			FUNC	ICREW SUPPT	SUPPT	MANHOURS	OURS	
NUMBER	TASK	FACILITIES			TRNG	¥.	MI.	EVA	EVA	TOTAL	REMARKS
4.2.5.1.4	Remove and Replace PU or TVS	SS hangar, lighting, power, signal, propellant	hangar, Control console, SS computer, inting, irobotics, CCTV, tools/er, effectors, PU or TVS LRUs, inal, test equipment pellant	computer,     1s/   S LRUs,	_	2:10	1:30			1:30	,
4.2.5.1.4.1	Translate robotics to tool area – secure tools/effectors and test equipment		Control console, SS computer,  robotics, CCTV, tools/  effectors	computer, 1s/		0:02					
4.2.5.1.4.2	Translate robotics to parts Storage area secure PU or TVS LRUs		Control console, SS computer, Irobotics, CCTV, PU or TVS LRU effectors	computer, or TVS LRU		0:02					
4.2.5.1.4.3	Translate robotics to work		Control console, SS computer	computer		0:02		. —			
4.2.5.1.4.4	Remove PU or TVS		Control console, SS computer,  robotics, CCTV, tools/  effectors	computer, is/	~	0:50	0:20			0:20	
4.2.5.1.4.5	Install new PU or TVS		Control console, SS computer,  robotics, CCTV, tools/  effectors	computer, 1s/	~	0:50	0:20			0:20	
4.2.5.1.4.6	Install/checkout/calibrate  PU or TVS test equipment		Control console, SS c  robotics, CCTV, test  equipment	SS computer, test	~	0:15	6:15			0:15	
4.2.5.1.4.7	Conduct PU or TVS checkout		Control console, SS computer	computer		0:15					Correct anomalies
4.2.5.1.4.8	Disconnect and store test equipment in robotics		Control console, SS robotics, CCTV	SS computer,	2	0:15	51:0	<del></del>		0:15	
4.2.5.1.4.9	Translate robotics to parts larea, package unserviceable  PU or TVS		Control console, SS robotics, CCTV	SS computer,		0:20	0:20			0:50	Return to earth
4.2.5.1.4.10	Translate robotics to tool  area - secure tools/  effectors and test equipment		Control console, SS computer,  robotics, CCTV	s computer,		0:02					
4.2.5.1.4.11	Translate robotics to storage area and secure		Control console, SS computer	s computer		0:02					
								/1/	1.1.		FINDW WINDW

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CENTENCE		DENITOCALNIC	MILE	FILMS TERFOR SIDENT I MANHOLIRS	I TOOL	MANHONIRS	
NUMBER	TASK	FACILITIES  TOOLS	ITRNG ITIME	IVA	EVA EVA	I TOTAL	REMARKS
4.2.5.1.5	Tank Reconfiguration See 4.2.5.1.	SS hangar,   Control console, SS computer,   Ilighting,   robotics, RMS, CCTV, tools/   power,   effectors, propellant tank(s)   propellant     propellant	):  	3:00 2:20		2:20	2:20 3:00 hrs/tank

OTV POSTMISSION PROCESSING - STORABLE

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SEQUENCE			REQUIREMENTS			ICREM SUPPT		S	IRS	
NUMBER	TASK	FACTLYTIES	\$ T00LS	TRIBE	¥.	TAY.	l i	EVA ITC	TOTAL	REMARKS
4.2.5.2	Avionics Unscheduled Maintenance									
4.2.5.2.1	Module Replacement	SS hangar, lighting, signal, power, propellant	Control console, SS computer, ICCTV, robotics, tools/ leffectors, test equipment ti		1:50	0:55			0:55	
4.2.5.2.1.1	Translate robotics to tool area; secure tools/effectors		Control console, SS computer, robotics, CCTV		0:05					
4.2.5.2.1.2	Translate robotics to parts storage; secure replacement module		Control console, SS computer, robotics, CCTV		0:02					
4.2.5.2.1.3	Translate robotics to work site		Control console, SS computer, robotics, CCTV		0:05					
4.2.5.2.1.4	Remove and store avionics  module		Control console, SS computer, robotics, CCTV, tools/ effectors	2	0:15	0:15			0:15	
4.2.5.2.1.5	Inspect module mounting interface for defects		Control console, CCTV, robotics	~	0:02	0:05			0:02	
4.2.5.2.1.6	Install replacement module		Control console, SS computer,  robotics, CCTV, tools/  effectors	2	0:15	0:15			0:15	
4.2.5.2.1.7	Conduct module test/checkout		Control console, SS computer		0:30	:			<u>-</u> <u>-</u> -	Correct anomalies
4.2.5.2.1.8	Translate robotics to parts  storage; package unservice-  able module		Control console, SS computer, robotics, CCTV		0:20	0:20			0:20   Re	Return to earth
4.2.5.2.1.9	Translate robotics to tool storage area; secure tools/effectors		Control console, SS computer, robotics, CCTV		0:02					
4.2.5.2.1.10	Translate robotics to  storage and secure		Control console, SS computer		0:05					

OTV POSTMISSION PROCESSING - STORABLE

TACE	2016111040	REQUIRENENTS	51 GE	FUNC	اعدا	SUPPT	MANHOURS	
Remove and Replace Antenna System	SS hangar, 11ghting, power, signal, propellant	Control conscitools/effect		2:20	1:25		+	1:25   KEMAKAS
Translate robotics to tool area; secure tools/effectors and test equipment	umbilicals	Control console, SS computer, robotics, CCTV		90:02				
Translate robotics to parts storage area - secure and store replacement parts		Control console, SS computer, robotics, CCTV		0:02				
Translate robotics to work site		Control console, SS computer		0:05		<del></del> -	<del></del> -	
Disconnect antenna cabling		Control console, SS computer, robotics, CCTV, tools/ effectors	~~	0:10	0:10			0:10
Disconnect, remove and store antenna system		Control console, SS computer, robotics, CCTV, tools/ effectors		0:20	0:20			0:20
Install serviceable antenna system		Control console, SS computer, robotics, CCTV, tools/	~	0:20	0:20			0:20
Reattach RF cabling		Control console, SS computer, robotics, CCTV, tools/ effectors	~	0:15	0:13		ö 	0:15
Conduct test on antenna system		Control console, SS computer, test equipment		0:30				Correct anomalies
Translate robotics to parts storage area; package antenna system		Control console, SS computer, robotics, CCTV		0:20	0:20		- <del></del>	0:20 Return to earth
Translate robotics to tool storage area and secure tools		Control console, SS computer, robotics, CCTV	<del></del>	0:05	1			
Translate robotics to storage area and secure		Control console, SS computer A-231	<u></u>	0:02		IMA j	122	MARTIN MARIETTA

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OTY POSTMISSION PROCESSING - STORABLE

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SEDITE NO.			REQUIREMENTS	IFUNC	ICREW	ICREW SUPPT   MANHO	MANH	DURS	
NUMBER	TASK	FACTLITIES	T00LS	ITRNG ITIME	ΥAI	IEVA	EVA	TOTAL	REMARKS
4053				<b></b>					
	- TBD								
4.2.5.4	Unscheduled Engine								
	Maintenance-TBD								

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SEQUENCE	TACK	FACTITIES	REQUIREMENTS TOOLS	TRNG TIME		ICREW SUPPI IVA IEVA		I MANHOURS Teva Itotal	REMARKS
4.2.5.5	ce Turbopump	SS hanger, signal, power,		<u>'</u>	4:40	3:30		3:30	4:40/Turbopump
4.2.5.5.1	Translate robotics to tool area - secure and stow tools/effectors and special removal tools	propeilant lumbilical lighting	Control console, SS computer, CCTV		0:02				·
4.2.5.5.2	Translate robotics to parts larea - secure and stow replacement turbopump		Control console, SS computer, CCTV		0:05				
4.2.5.5.3	Translate robotics to work site		Control console, SS computer, CCTV		0:02				
4.2.5.5.4	Install turbopump installation tools		Control console, SS computer, ICCTV, tools/effectors, special tools	~~~~	0:50	0:50		0:20	
4.2.5.5.5	Disconnect turbopump		Control console, SS computer, ICCTV, tools/effectors,	~	0::0	0::0		0:10	0
4.2.5.5.6	Remove turbopump		Control console, SS computer,  CCTV, tools/effectors,	~	0:30	0:30		0:30	0
4.2.5.5.7	Install turbopump installation tools		Control console, SS computer, [CCTV, tools/effectors,	~	0:45	0:45		0:45	
4.2.5.5.8	Position turbopump and	· 	Control console, SS computer, ICCTV, tools/effectors,	~	0:10	0:10		0:0	0
4.2.5.5.9	  Remove installation tools		Control console, SS computer,  CCTV, tools/effectors,	~	0:50	0:20		0:20	
4.2.5.5.10	Connect checkout equipment		Control console, SS computer, ICTV, tools/effectors,   special tools	2	0:15	0:15		0:15	•
4.2.5.5.11	Conduct leak check and electrical check		Control console, SS computer, test equipment		0:40				Correct anomalies
4.2.5.5.12	Remove checkout equipment		Control console, SS computer,		0:15	0:15		0:15	
4.2.5.5.13	Translate robotics to parts larea		Control console, SS computer, ICTY A-233		0:05		MA		MARTIN MARIETTA

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SEOTIENCE		Ŀ	REQUIREMENTS		FUNC	CREW S		IFUNC ICREM SUPPT   MANHOURS	OURS	
NUMBER	TASK	FACTLITIES	T00LS	TRMG	TRNG TIME	YA!	EVA	IEVA IEVA ITOTAL	TOTAL	REMARKS
4.2.5.5.14	Package turbopump for   shipment		Control console, SS computer, CCTV, tools/effectors,		0:15  0:15	0:15			0:15	0:15 Return to earth
4.2.5.5.15	Translate robotics to tool area - secure tools		Control console, SS computer		0:05					
4.2.5.5.16	Secure robotics		Control console, SS computer		0:05					

OTV POSTMISSION PROCESSING - STORABLE

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SEOTENCE			STNANSGLISONG		UNIM	Addits Made	144	MANITOTIES	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	Т	IVA	1	EVA TOTAL	REMARKS
4.2.5.6	Aerobrake Unscheduled Repair	SS Hangar, ( lighting, power, signal,	Control conso Cobotics, CCT special tools		101			1	
4.2.5.6.1	Translate robotics to tool storage area; secure tools/effectors		Control console, SS computer, robotics, CCTV		0:02				
4.2.5.6.2	Translate robotics to parts storage area; secure repair kit		Control console, SS computer, robotics, CCTV		0:05				
4.2.5.6.3	Translate robotics to aerobrake work site		Control console, SS computer		0:05			<del></del>	
4.2.5.6.4	Verify whether damaged area is within prescribed repairable tolerance		Control console, SS computer, robotics, CCIV, measuring tool	~	0:10	0:10		0:10	
4.2.5.6.5	Prepare area for repair		Control console, SS computer, robotics, CCIV, tools	7	0:30	0:30		0:30	
4.2.5.6.6	Complete repairs		Control console, SS computer, robotics, CCIV, tools	8	1:20	1:20		1:20	· <del></del> -
4.2.5.6.7	Verify curing/setup requirements		SS computer		0:05			<del></del>	
4.2.5.6.8	Conduct required repair test		Control console, SS computer, CCTV, robotics	8	0:30	 %	. <del></del>	0:30	Visual, pull, etc.
4.2.5.6.9	Translate robotics to parts storage area		Control console, SS computer, robotics, CCIV,		0:02				
4.2.5.6.10	Translate robotics to tool storage area, secure tools/effector		Control console, SS computer, robotics, CCTV,	4	0:05		·	<del></del>	
4.2.5.6.11	Translate robotics to storage area and secure		Control console, SS computer,		0:05			·	· <del></del>

· REMARKS										Correct anomolies			Return to earth MARITIA
MANHOURS	1:45				0:30	0:02	0:30	0:05	0:10	Corr		0:10	MARTIN MARI
-P													AM
CREW SUPPT	1:45				0:0	50:02	0:30	0:03	0:10			0:10	0:15
FUNC	2:30	0:05	0:02	0:02	0:30	0:02	0: 30	0:02	0:10	0:15	0:02	0:10	0:15
TRNG					~		~	2	. <del></del> -	~	7	~	
REQUIREMENTS TOOLS	hangar, Control console, SS computer, hting, Trobotics, CCTV, special nal, tools/effectors, LRU's, er, test equipment pellant	Control console, SS computer, robotics, CCTV	Control console, SS computer, robotics, CCTV	Control console, SS computer	Control console, SS computer,  robotics, CCTV, tools/  effectors	Control console, SS computer,  robotics, CCTV	Control console, SS computer, robotics, CCTV	Control console, SS computer, robotics, CCTV	Control console, SS computer, robotics, CCIV	Control console, SS computer	Control console, SS computer	Control console, SS computer, robotics, CCTV	Control console, SS computer, Irobotics, CCTV A-236
FACILITIES	SS hangar, lighting, signal, power, propellant												
TASK	ce Regulator	Translate robotics to tool storage area, secure and store tools/effectors	Translate robotics to parts storage area, secure and store required LRU's	Translate robotics to work site	Release and remove unserviceable regulator/ control'package and store	Inspect regulator/control package interface; repair as required	Align and install regulator control package	Verify mechanical interfaces are secure	Install leak detection equipment	Pressurize appropriate system	Depressurize system	Remove leak check detection equipment	Translate robotics to parts storage area; package unserviceable components
SEQUENCE	4.2.5.7	4.2.5.7.1	4.2.5.7.2	4.2.5.7.3	4.2.5.7.4	4.2.5.7.5	4.2.5.7.6	4.2.5.7.7	4.2.5.7.8	. 4.2.5.7.9	4.2.5.7.10	4.2.5.7.11	4.2.5.7.12

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SEOTENCE			REQUIREMENTS	ſ	UNC	CREW SU	PPT T	IFUNC ICREM SUPPT I MANHOURS		
NUMBER	TASK	FACILITIES	TOOLS	TRNG	THE	IVA TE	A IE	/A   T0	IL I REMARKS	KS
4.2.5.7.13	Translate robotics to tool storage area; secure tools/effector		Control console, SS computer, robotics, CCTV		0:05					
4.2.5.7.14	Translate robotics to storage area and secure		Control console, SS computer		0:05	- <b></b>				

O'TV POSTHISSION PROCESSING - STORABLE

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SEQUENCE			REQUIREN				CREW SUPPT	$\perp$	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	# <u></u>	TRNC   T1	TIME	IVA EVA		TOTAL	REMARKS
4.2.5.8	Remove and Replace Mul, LH2,LO2, NTO, H2O, He, Tanks	SS hangar lighting, signal, power, propellant umbilicala	Control console, SS CCIV, robotics, spec tools, test equipmen	computer,		2:10	1:25		1:25	
4.2.5.8.1	Translate robotics to tool storage area, secure and store tools/effectors		Control console, SS com	SS computer,   1		0:05	·			
4.2.5.8.2	Translate robotics to part storage area, secure and store required IRUs		Control console, SS com  CCTV, robotics   .	SS computer, 1		0:02	. — — .			
4.2.5.8.3	Translate robotics to the designated work site		Control console, SS computer	puter   1		0:05				
4.2.5.8.4	Release, remove and store unserviceable sphere		Control console, SS computer, robotics, CCTV, tools/effectors	puter, 2		0:20	0:20		0:20	
4.2.5.8.5	Inspect interface area for damage, repair as necessary		Control consule, 55 com	computer, 2		0:02	0:05		0:05	
4.2.5.8.6	Align and install replacement sphere		Control console, SS computer, robotics, CCTV, tools/effectors	puter, 2	. —	0:20	0:20		0:20	
4.2.5.8.7	Verify mechanical interfaces are seated		Control console, SS com   robotics, CCTV	computer,   2		0:05	0:05	- <del>-</del> -	0:02	
4.2.5.8.8	Attach leak detection equipment		Control console, SS computer, robotics, CCTV, tools/effectors	puter, 2		0:10	0:10		0:10	
4.2.5.8.9	Pressurize sphere		Control console, SS computer	puter   2		0:15	<b></b> -			Correct anomolies
4.2.5.8.10	Depressurize sphere		Control console, SS computer	nputer   2		0:05			 · 	
4.2.5.8.11	Remove leak detection equipment		Control console, SS computer, robotics, CCTV	puter, 2		0:10	0:10		0::0	

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SEDIFICE			REQUIREMENTS		FUNC	CREW S	UPPT	FUNC CREW SUPPT I MANHOURS	
HUMBER	TASK	FACILITIES	T00LS.	TRMG	TIME	IVA	EVA	IRNG ITINE IIVA IEVA IEVA ITOTAL	REMARKS
4.2.5.8.12	Translate robotics to parts storage area; package unserviceable components		Control console, SS computer, robotics, CCTV		0:15  0:15	0:15			0:15 Return to earth
4.2.5.8.13	Translate robotics to tool storage area; secure tools/effector	<u> </u>	Control console, SS computer, robotics, CCTV		0:05				
4.2.5.8.14	Translate robotics to storage area and secure		Control console, SS computer,		0:05				

OTV POSTMISSION PROCESSING - STORABLE

			4.50.00		XIIII X	TARREL PUREN	TEN T	THE PERSON NAMED IN	3615
SEQUENCE NUMBER	TASK	FACILITIES	KEQUIKEMENIS TOOLS	TRNG	- 1 1	TVA	_1 1	EVA TOTAL	TOTAL   REMARKS
4.2.5.9	Remove and Replace Payload Interface System	SS hangar,    1ighting,   power,   signal,	ir, Control console, SS computer, y, robotics, RMS, CCTV, Tools/ leffectors, test equip, LRU's		4:00	2:40			2:40
4.2.5.9.1	Translate robotics to tool storage area; secure and store tools/effector		Control console, SS computer,  robotics, CCTV		0:05		- — — <sub></sub>		
4.2.5.9.2	Translate robotics to parts storage area, secure and store required parts		Control console, SS computer  robotics, CCTV		0:05				
4.2.5.9.3	Translate robotics to work site		Control console, SS computer,		0:02				
4.2.5.9.4	Translate RMS to work site and attach to payload interface system grapple fixture		Control console, SS computer,	~ .	0:10	0::0		- <del></del>	0:10
4.2.5.9.5	Release payload interface  system	·	Control console, SS computer, ICCTV, robotics, tools/effectors	2	0:30	0:30			0:30
4.2.5.9.6	Remove and translate unserviceable payload interface system to parts area and secure		Control console, SS computer,  CCTV, RMS	~	0:50	0:20			0:20
4.2.5.9.7	Secure serviceable payload interface system with RMS		Control console, SS computer, CCTV, RMS	~	0:02		·		
4.2.5.9.8	Translate payload interface  system to work site	. — — -	Control console, SS computer	~	0:20	0:20			0:20
4.2.5.9.9	Inspect payload interface  mounting area; repair as  necessary		Control console, SS computer, CCTV, robotics	~	0:10	0::0			0:10
4.2.5.9.10	Align payload interface system with RMS		Control console, SS computer, RMS, CCTV, robotics	2	0:10	0:10			0:10
4.2.5.9.11	Install and secure payload		Control console, SS computer, CCTV, robotics	7	0:10	0:10			0:10
		- <b>-</b>	I A-240				M	<b>4 1 1 1</b>	MARTIN MARIETTA

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SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPT	PPT	MANHOURS	IRS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TIME	IVA	EVA TE	EVA  TC	TOTAL	REMARKS
4.2.5.9.12	Install test equipment		Control console, SS computer, CCIV, robotics	~~~	0:15  0:15	0:15			0:15	
4.2.5.9.13	Conduct system test		Control console, SS computer	~	0:45				<u> </u>	Correct anomolies
4.2.5.9.14	Remove test equipment and store		Control console, SS computer, CCIV, robotics,	~	0:15  0:15	0:15			0:15	
4.2.5.9.15	Translate RMS to storage area and secure		Control console, SS computer		0:05					
4.2.5.9.16	Translate tobotics to parts area, package unserviceable payload interface system		Control console, SS computer,  CCIV, robotics,		0:20   0:20	0:20			: 20 Re	0:20 Return to earth
4.2.5.9.17	Translate robotics to tool storage area; store tools/ effectors		Control console, SS computer, CCTV, robotics,		0:05					
4.2.5.9.18	Translate tobotics to storage area and secure		Control console, SS computer		0:05					

OTV POSTMISSION PROCESSING - STORABLE

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	REMARKS										nolles		
				·	. <b></b> .	ن <u>ہ</u> کے نے					Correct anomolies		
MANHOURS	TOTAL	1:45				0:30	0:02	0:30	0:15				0:15
$\vdash$									<b></b>	_ —			
ICREW SUPPT	IVA	1:45				0:30	10:05	0:30	0:15				0:15
FUNC	-	2:35	0:02	0:02	0:02	0:30	0:02	0:30	0:15	0:05	0:15	0:05	0:15
	ITRNG					~		~		7			
REGUTREMENTS		r, Control console, SS computer, tools/effectors, LRU's robotics, test equipment CCTV	Control console, SS computer,  robotics, CCTV	Control console, SS computer,  robotics, CCTV	Control console, SS computer	Control console, SS computer,   robotics, CCTV, tools/   effectors	Control console, SS computer, robotics, CCTV	Control compole, SS computer,   robotics, CCTV, tools/   effectors	Control console, SS computer, robotics, CCIV,	Control console, SS computer	Control console, SS computer	  Control console, SS computer	Control console, SS computer,   robotics, CCTV
	FACILITIES	SS hangar, [11ghting, power, signal, propellant											
	TASK	Remove and Replace Main Propellent Tank Pressure System	Translate robotics to tool storage area; secure and store tools/effectors	Translate robotics to parts storage area; secure and store LRU's	Translate robotics to work site	Detach, remove and store unserviceable tank press	Inspect tank press system	Align, install and secure serviceable tank press system	Install leak check equipment	Pressurize system	Conduct leak check	  Depressurize tank press  system	Disconnect and remove test
SEOTENCE	NUMBER	4.2.5.10	4.2.5.10.1	4.2.5.10.2	4.2.5.10.3	4.2.5.10.4	4.2.5.10.5	4.2.5.10.6	4.2.5.10.7	4.2.5.10.8	4.2.5.10.9	4.2.5.10.10	4.2.5.10.11

OTY POSTMISSION PROCESSING - STORABLE

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	REMARKS	earth		
		0:10 Return to earth		
TEUNC ICREM SUPPT   MANHOURS	TRNG ITINE IVA LEVA LEVA ITOTAL	0:10		
MAK	IEVA			
SUPPT	EVA			
ICREV	IIVA	0:10 0:10		
FUNC	TIME	0:10	0:02	0:02
	TRNG			
PENITREMENTS			Control console, SS computer,  robotics, CCTV	Control console, SS computer
	FACILITIES			
	TASK	Translate robotics to part   storage area; package   unserviceable system	Translate robotics to tool	Translate robotics to storage area and secure
PENIFUE	NIMBER	4.2.5.10.12	4.2.5.10.13	4.2.5.10.14

OTV POSTMISSION PROCESSING - STORABLE

SHEET 43 of 46

CENTENTE			REDITREMENTS		FUNC	CREW SUPPT	T T d d	HANHOURS	URS	
NUMBER	TASK	FACTLITIES	T00LS	TRNG ITIME		YAL.	1 1	EVA TOTAL	OTAL	REMARKS
4.2.5.11	Main Structure Replacement	Hangar, lighting, power, signal, propellant	Control console, SS computer, I-robotics, RMS, CCTV, tools/ leffectors, test equipment, LRU's, special tools		81:55	50:10		<u>.ŭ </u>		
4.2.5.11.1	Translate robotics to tool storage area, secure and store required tools/effectors		Control console, SS computer,		0:05					
4.2.5.11.2	Translate robotics to parts storage area, secure and store required LRU's		Control console, SS computer,		0:05	. — — —				
4.2.5.11.3	Translate robotics to designated work site		Control console, SS computer,		0:05					
4.2.5.11.4	Translate RMS to  designated work site		Control console, SS computer,		0:05					
4.2.5.11.5	Remove payload interface system (see 4.2.5.9)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	0:55	0:55			0:55	
4.2.5.11.6	Remove antenna system  (See 4.2.5.2.2)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	0:30	0:30			0:30	
4.2.5.11.7	Remove avionics modules  (See 4.2.4.2.2)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	7:00	7:00			7:00 [21     per	2] Total modules - 20 minutes per module
4.2.5.11.8	Remove propellant tanks -  4 ea (See 4.2.5.1.1)  (1 hr/tnk)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	4:00	4:00			4:00 	l hour per tank
4.2.5.11.9	Remove aerobrake and support  (See 4.2.4.5.2)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	1:00	1:00			 8:	
4.2.5.11.10	Remove engines  (See 4.2.4.4.3)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors, special tool	2	2:50	2:50			2:50   1:2	1:25 hrs per engine

OTV POSTMISSION PROCESSING - STORABLE

SHEET 44 of 46

SEQUENCE			REQUIREMENTS		FUNC	-		3	
NUMBER	TASK	FACILITIES	LOOLS	TRNC	TIME	IVA	EVA	EVA TOTAL	IL REMARKS
4.2.5.11.11	Remove Muli, LH2, NTO, H20, He tanks (See 4.2.5.8)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	1:15	1:15			1:15   25 minutes per sphere
4.2.5.11.12	Remove regulator/control packages (See 4.2.5.7)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	1:45	1:45		<del></del>	1:45 35 minutes per package
4.2.5.11.13	Remove main propellant tank pressure system (See 4.2.5.10)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	8	1:10	1:10		<del>-</del>	1:10   55 minutes per system
4.2.5.11.14	Attach RMS to main structure		Control console, SS computer, RMS, CCTV	7	0:10	0:10		0:10	- <del></del>
4.2.5.11.15	Translate RMS to parts area and secure unserviceable main structure		Control console, SS computer, RMS, CCTV	~	0:30	0:30		0:30	<del></del>
4.2.5.11.16	Translate RMS to OTV berthing area, with serviceable main structure and secure to berthing cradle		Control console, SS computer, RMS, CCIV,	7	0:30	0:30		0:30	
4.2.5.11.17	Install main propellant tank pressure system (See 4.2.5.10)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	1:10	1:10			1:10
4.2.5.11.18	Install MeH, LH2, H20, He tanks (See 4.2.5.8)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	1:15	1:15		- <del></del> -	1:15
4.2.5.11.19	Install regulator/control packages (See 4.2.5.7)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	1:45	1:45			1:45
4.2.5.11.20	Install main engines (See 4.2.4.4.3)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors, special tool	~	2:50	2:50			2:50
4.2.5.11.21	Install aerobrake and support (See 4.2.4.5.2)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	1:00	1:00		1:00	

SHEET 45 of 46

			KEKITOKETETIFE			VOEU C	1901	MANUALIBE	יוב
SEQUENCE NUMBER	TASK I	FACILITIES	KEŲOJKEMENIS TOOLS	ITRNG		IVA	_i i	EVA TO	TOTAL I REMARKS
4.2.5.11.22	Install propellant tanks -   4 ea (See 4.2.5.1.1)	·	Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	2	4:00	6:00			4:00
4.2.5.11.23	Install avionics modules [See 4.2.4.2.2]		Control console, SS computer, RMS, robotics, CCTV, tools/ leffectors	~	7:00	7:00			7:00
4.2.5.11.24	Install antenna system (See 4.2.5.2.2)		Control console, SS computer, IRMS, robotics, CCTV, tools/ leffectors	~~~~	0:30	0:30			0:30
4.2.5.11.25	Install payload interface  system (see 4.2.5.9)		Control console, SS computer, RMS, robotics, CCTV, tools/ effectors	~	0:55	0:55			0:55
4.2.5.11.26	Attach power, signal and propellant umbilicals		Control console, SS computer, Irobotics, CCTV,		0:20	0:20			0:20
4.2.5.11.27	Install and checkout test equipment		Control console, SS computer,  robotics, CCTV,	8	2:00	2:00			2:00
4.2.5.11.28	Conduct subsystem and system checkout; correct anomalies		Control console, SS computer	1+2	32:00	0:1			1:00  Correct anomolies
4.2.5.11.29	Disconnect and store test lequipment		Control console, SS computer, CCTV, robotics	2	2:00	5:00			2:00
4.2.5.11.30	Translate RMS to storage area and secure		Control console, SS computer		0:02				
4.2.5.11.31	Translate robotics to parts storage area; store serviceable parts; package unserviceable parts		Control console, SS computer, robotics, CCTV		3:00	3:00			3:00 Return to earth
4.2.5.11.32	Translate robotics to tool  storage area; store tools/  effectors		Control console, SS computer, robotics, CCTV		0:05				
4.2.5.11.33	Translate robotics to storage area and secure		Control console, SS computer		0:02				

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OTV POSTMISSION PROCESSING - STORABLE

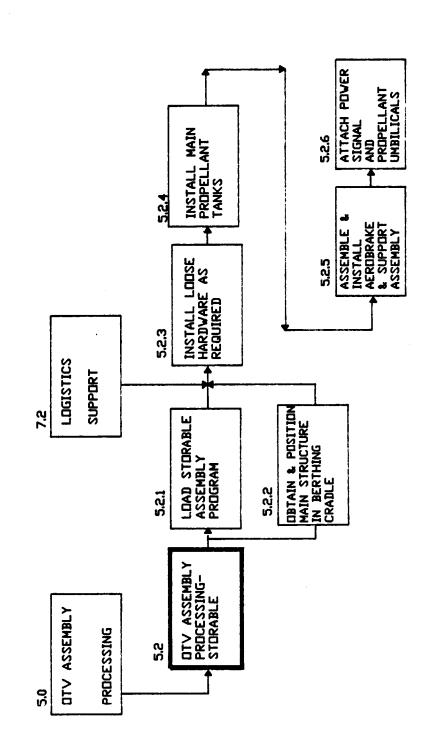
SHEET 46 of 46

SEOUENCE			REOUTREMENTS		3	FUNC   CREW SUPPT	_ ₩	MANHOURS	
NUMBER	TASK	FACILITIES		TRNG	TRNG ITIME	IVA EVA EVA ITOTAL	EVA	TOTAL	REMARKS
4.2.6	Verify Maintenance Complete				1:15	1:15		1:15	
4.2.6.1	Verify all maintenance completed per maintenance plan		Control console, SS computer		0:15 0:15	0:15		0:15	
4.2.6.2	Verify all anomalies  corrected and diagnostic  tests completed		Control console, SS computer		0:20 0:20	0:50		0:50	
4.2.6.3	Verify OTV safed		Control console, SS computer		0:40 0:40	0:40		0:40	

## STORABLE SPACE-BASED OTV ASSEMBLY PROCESSING

The Storable SBOTV is also initially delivered to Space Station unassembled, and this functional flow and requirements definition set identifies the operations associated with initial assembly of the Storable SBOTV.

#### STORABLE 1 SBOTV ASSEMBLY PROCESSING



SHEET 1 OF 8

OTV ASSEMBLY PROCESSING - STORABLE

KS	will be isually to transfer g area	d h gore	<b>50</b>		
REMARKS	Components/parts will be unpackaged and visually inspected prior to transfer to the processing area	0:30   Task accomplished	structure bertaing		
MANHOURS VA [TOTAL	11:15	0:30	0:02	0:15	0:10
SUPPT	ສ				
- ( 1 1	11:15	0:30 0:30	0:05 0:05	0:15 0:15	0:10 0:10
FUNC	22:40		- <del>-</del> -		- <del>-</del>
TRNC					
REQUIREMENTS 1 TOOLS	SS computer, control console,   Irobotics, RMS, CCTV, tools/   effectors, test equipemnt	SS computer, control console	  Control console, SS computer	Control console, Sa computer	
FACILITIES	SS hanger lighting, aignal, power, propellant umbilicals				
TASK	OTV Assembly Processing - Storable	Load Storable Assembly Program	Verify correct program	Verify all applicable OTV modifications are incorp- orated in assembly program	Load and verify proper assembly operations
SEQUENCE NUMBER	5.2	5.2.1	5.2.1.1	5.2.1.2	5.2.1.3

OTV ASSEMBLY PROCESSING - STORABLE

SHEET 2 OF 8

SEQUENCE			REQUIREMENTS		FUNC	FUNC CREW SUPPT		MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TIME	IVA EVA EVA TOTAL	EVA	TOTAL	REMARKS
5.2.2	Obtain and Position Main Structure in Berthing Cradle		SS computer, control console, RMS, CCTV, robotics		1:00	1:00		1:00	1:00 Task accomplished concurrently with assembly program loading.
5.2.2.1	Translate OTV from storage area		SS computer, control console, RMS, CCTV	~	0:20	0:20		0:20	
5.2.2.2	Extend cradle interfaces and lock in place		SS computer, control console, robotics, CCTV	~	0:30	0:30		0:30	0:30 OTV cradle interfaces will be folded to meet cargo bay limitations
5.2.2.3	Position main structure in berthing cradie and secure		SS computer, control console, RMS, CCTV, robotice	~	0:10	0:10		0:10	

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|Conduct inventory of parts/ |hardware kit. |Support will be folded to | |meet shuttle cargo bay | |Timitations. REMARKS 0:10 1:00 9: 2:30 0:20 ICREW SUPPT | WANHOURS 0::0 8 ::0 00:1 0:50 2:30 0:10 0:0 9:00 0:50 2:45 0:05 0:05 0:05 TRNG | TIME ~ ~ ~ SS computer, control console, robotics, CCTV SS computer, control console, robotics, CCTV ISS computer, control console, ICCTV SS computer, control console, CCTV SS hangar, SS computer, control console, lighting, RMS, CCTV, robotics, tools/ signal, effectors, test equipment SS computer, control console, robotics, CCTV SS computer, control console, robotics, CCTV, tools/ effectors SS computer, control console REQUIREMENTS TOOLS FACILITIES power, umbilical Translate robotics to tool storage area, secure and stow required tools/effectors Extend propellant tank supports and lock in place |Verify all loose hardware Verify all packaging material is removed from OTV interfaces storage area, secure and stow required hardware Install Loose Hardware franslate robotics to Translate robotics to Install hardware as required OTV processing area TASK SEQUENCE NUMBER 5.2.3.6 5.2.3.4 5.2.3.5 5.2.3.3 5.2.3.7 5.2.3.1 5.2.3.2 5.2.3

SHEET 3 OF 8

OTV ASSEMBLY PROCESSING - STORABLE

SHEET 4 OF 8

SEQUENCE			REQUIREMENTS				CREW SUPPT		MANHOURS	
NUMBEK	TASK	FACILITIES	TOOLS	TRNC	K TIME		'A EVA	EVA	TOTAL	REMARKS
5.2.4	Install Main Propellant Tanks		SS computer, control console, CCIV, RMS, robotics, tools/effectors		 	4:10	4:10		4:10	Pour (4) tanks require intallation. 1 Hr/Tank
5.2.4.1	Translate RMS to parts atorage area. Secure tank and translate to work site		SS computer, control console, CCIV, RMS			0:50	0:20		0:20	
5.2.4.2	Inspect tank interfaces with robotics prior to tank installation		SS computer, control console, CCTV, robotics			0:10	0:10		0:10	
5.2.4.3	Verify sufficient clearance between robotics and RMS with tank		SS computer, control console		' 		_ <del></del> _		I 	
5.2.4.4	Position/align tank with OTV attaching points and insert onto tank interface		SS computer, control console, CCIV, robotics, RMS			0:10	0:10		0:10	
5.2.4.5	Secure tank at attaching point 2 with robotica		SS computer, control console, CCTV, robotics, RMS		 	0:10	0:10		0:10	
5.2.4.6	Secure tank at attaching point 1 with robotics		SS computer, control console, CCTV, robotics, RMS		- <del></del> -	0:10	0:10		0:10	
5.2.4.7	Release RMS from tank		SS computer, control console,		- <del>-</del> -	- <u>-</u> -	- <b>-</b> -			
5.2.4.8	Complete steps 5.1.4.1 thru 5.2.4.7 for remaining tanks		SS computer, control console, CCIV, robotics, RMS	le,		 			\ 	
5.2.4.9	Install, checkout and calibrate leak detection equipment		SS computer, control console, CCTV, robotics			0:10	0:10		0:10	Following last tank installation

SHEET 5 OF 8

OTV ASSEMBLY PROCESSING - STORABLE

REMARKS						· • • • •				
MANHOURS	5:00		0:10	0:30	0::0	0:50		0:50		0:10
HARI		=								
CREW SUPPT						-5				
CREW			0:10	0:30	0::0	0:20		0:50		0:10
FUNC	2:35	0:05	0:10	0:30	0:10	0:50	0:10	0:50	0:02	0:10
TOME	i .			~	~	~	~	~		2
REQUIREMENTS	SS computer, CCTV, robotic and effectors	SS computer, control console   SS computer, control console	  SS computer, control console,  RMS, CCTV	SS computer, control console,  RMS, CCTV, robotics, tools/  effectors	SS computer, control console, RMS, CCTV, robotics, tools/ effectors	SS computer, control console,  RMS, GCTV, robotics, tools/  effectors	SS computer, control console,  CCTV, robotics, test  equipment	SS computer, control console,  CCTV, RMS	SS computer, control console	  SS computer, control console,  RMS, robotics, CCTV, tools/
ELC'H TYTE	SS hangar, lighting, signal, power, umbilicals									
7341	Assemble and Install Aerobrake and Support Assembly	Translate RMS to aerobrake storage area	aerobrake storage area   Secure aerobrake for  assembly	Unfold aerobrake and  support structure with  robotics	Secure aerobrake support  Tatches	Inject aerobrake outer ring with rigidizing compound	Conduct inspection of aerobrake, prior to installation on OTV	Translate RMS with assembled aerobrake to OTV processing area	Translate robotics to OTV processing area	Align and attach aerobrake   And support to core
SEQUENCE	5.2.5	5.2.5.1	5.2.5.3	5.2.5.4	5.2.5.5	5.2.5.6	5.2.5.7	5.2.5.8	5.2.5.9	5.2.5.10

SHEET 6 OF 8

OTV ASSEMBLY PROCESSING - STORABLE

SEQUENCE			REQUIREMENTS		FURE	FUNC ICREM SUPPT   MANHOURS	MAN	OURS		
NUMBER	TASK	FACTLITIES	T00LS	TRING	RING TIME	IVA LEVA LEVA	EVA	TOTAL	REMARKS	
5.2.5.11	Connect RCS propellant lines		SS computer, control console, robotics, CCTV, tools/	~	0:10	0:0		0::0		
5.2.5.12	Connect RCS power and signal lines		SS computer, control console, robotics, CCTV, tools/	~	0:02	0:02		0:02		
5.2.5.13	Install, checkout and  callbrate test equipment		<pre>SS computer, control console, Robotics, CCTV, tools/ effectors, test equipment</pre>	~	0:02	0:02		0:02		

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OTY ASSEMBLY PROCESSING - STORABLE

SEMIETINE.			REGITTREMENTS		FUNC	FUNC ICREM SUPPT I MANHOURS		NHOURS	
SEÇUE MCE NUMBER	TASK	FACTLITIES		TRNG	TIME	IVA IEVA	I EVA	ITOTAL	REMARKS
5.2.6	Install RF Antenna System		SS computer, control console, robotics, CCTV, tools/ effectors, test equipment		0:45	0:35		0:35	
5.2.6.1	Translate robotics to storage   area and secure required   RF antenna assemblies		SS computer, control console, CCTV	-	0:05				
5.2.6.2	Translate robotics to processing area		SS computer, control console		0:02				
5.2.6.3	Install antenna system		<pre>SS computer, control console,  robotics, CCTV, tools/ effectors</pre>	2	0:20	0:50		0:50	
5.2.6.4	Attach RF cabling as		ISS computer, control console, robotics, CCTV, tools/ effectors	2	0:15	0:15		0:15	
				_		<u> </u>	_		_

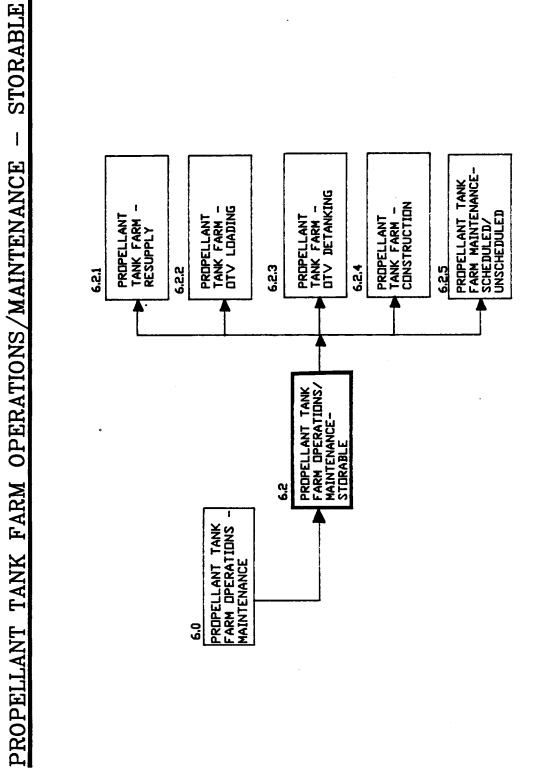
OTV ASSEMBLY PROCESSING - STORABLE

SHEET 8 OF 8

SEQUENCE NUMBER	TASK	FACILITIES	REQUIREMENTS TOOL	ENTS TOOLS		TRING	FUNC	TRNG TIPE IVA LEVA LOTAL	I WAN	TOTAL	REMARKS
5.2.7	Attach Power, Signal and Propellant Umbilicals		SS computer, control console, RMS, CCTV, robotics	ntrol co tics	nsole, [	- <del></del>	11:05	0:30		0:30	
5.2.7.1	Attach power, signal and propellant umbilicals to OTV		SS computer, control console, RMS, CCTV, robotics	ntrol co tics	onsole,		0:02				
5.2.7.2	  Verify power levels		SS computer, control console	ntrol co	nsole		0:10				
5.2.7.3	  Verify signal transmission		SS computer, control console	ntrol co	nsole		0:50				
5.2.7.4	Conduct OTV system checks		SS computer, control console	ntrol co	onsole		10:00	<b></b>			Correct anomolies - See
5.2.7.5	Verify OTV Safe		SS computer, control console	ntrol co	nsole	~ ~	0:30			0:30	activities

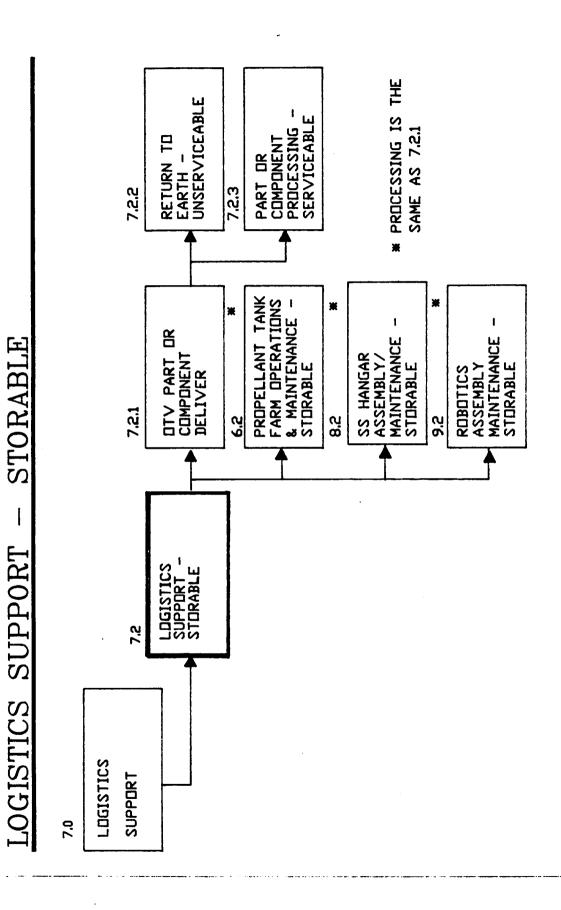
# STORABLE PROPELLANT TANK PARM OPERATIONS & MAINTENANCE

Space Station are shown on the facing page functional flow. Requirements definition sheets were being initiated when, upon receipt of the Revision 8 Mission Model, it was determined that the Storable OTV was no longer a viable candidate. Consequently, the requirements definition set for this flow was not The various aspects of assembling, operating, and maintaining the Storable propellant tank farm at completed.



## STORABLE SPACE-BASED OTV LOGISTICS SUPPORT

The logistics support operations associated with the Storable SBOTV and its attendant accommodations is shown on the facing page functional flow. Requirements definitions were not completed as a consequence of the deletion of the Storable OTV as a viable candidate.



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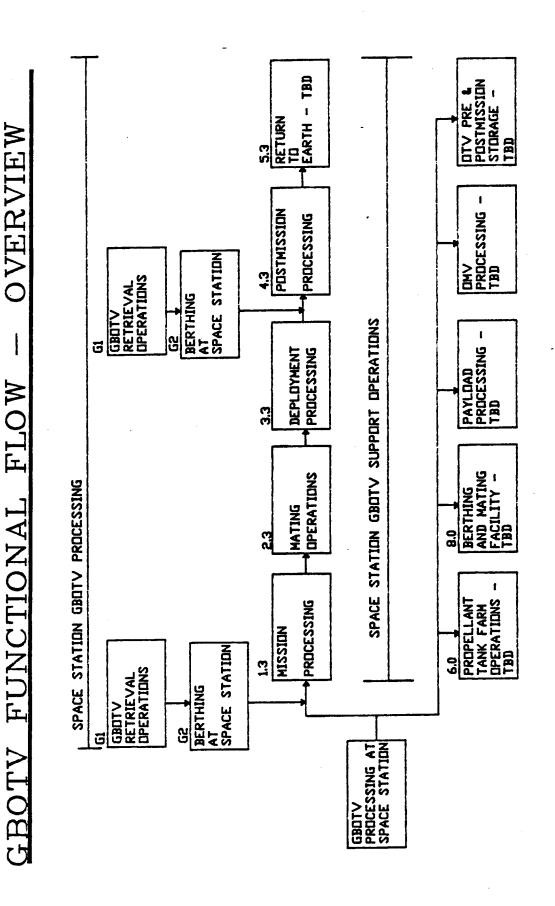
### **GROUND-BASED OTV**

### GROUND-BASED OTV FUNCTIONAL FLOW OVERVIEW

Unlike the Space-Based OTV, the Ground-Based OTV is delivered to Space Station fully assembled by the OMV. Also unlike the SBOTV, there are no provisions for service and maintenance of the GBOTV. Once its single mission has been completed, the GBOTV is partially disassembled, allowing Earth return in the Shuttle Cargo Bay. The equivalent of two Shuttle return flights are required to return a single Ground-Based OTV.

The following charts address the numbered operational blocks on the facing page chart.

#### MARTIN MARIETTA



### GROUND-BASED OTV RETRIEVAL OPERATIONS

Top level Ground-Based OTV retrieval operations, either for initial delivery to Space Station or upon return from a mission, are identified on the facing page functional flow and accompanying requirements definition.

#### G.2 BERTHING AT SPACE STATION G.1.3 DTV CAPTURED VITH SPACE CRANE G.1.2 DMV/DTV RETURN TD SPACE STATION GBOTV RETRIEVAL OPERATIONS G.1.1 RENDEZVOUS DAV VITH DTV GBOTV RETRIEVAL DPERATIONS

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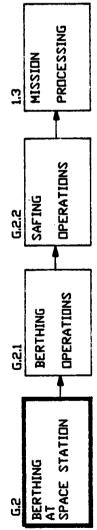
#### GDOTY RETRIEVAL OPERATIONS

	REMARKS	Ground control until OMV/OTV return to vicinity of the space station	Ground control	Control of OMV transferred to space station			
OURS	VA   TOTAL	3:00 00:	- <del>-</del>	2:25	0:10	0:50	<del></del>
MANIE	EVA						
MAN	-						
CREW	IVA EVA	3:00	, 	2:25	0:15	0:20	
FUNC	TIME	3:00	ı	2:25	0:15	0:20	
	TRNC		- <u>-</u> -	8	~ ~	8	
REOUIREMENTS	TOOLS	Control console, SS computer	Ground computer	Control console, SS computer	Control console, space crane, CCTV	Control console, SS computer, CCTV	•
	PACILITIES	Space station berthing area, communi- cations, space					 
	TASK	GBOTV RETREIVAL OPERATIONS	Rendevous OMV with OTV	OMV/OTV return to vicinity of the space station	Capture OTV with space crane	Demate OMV - Translate to berthing area	
SEQUENCE	NUMBER	6.1	6.1.1	G.1.2	6.1.3	6.1.3.1	PRECEDING PAGE BLANK NOT FILMED

#### GROUND-BASED OTV BERTHING

Ground-Based OTV berthing at Space Station, either upon initial delivery or upon return from a mission, are shown on the functional flow and following requirements definition.

# GBOTV BERTHING AT SPACE STATION



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SHEET 1 of 1

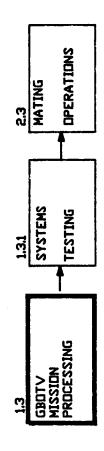
GBOTY BERTHING AT SPACE

	REMARKS										
MANHOFIES	A TOTAL	2:35		0:10	0:40	0:30	0:50	0:50	0:15	0:10	-
ICREW SUPPT	ITVA IEVA EVA	2:35		0:10	0:40	0:30	0:50	0:50	151:0	0:0	_
IFUNC	TRING ITIME	<u>\$6:5</u> -		0:10	2 0:40	2 0:30	2 0:20	2 0:20	2 0:15	2 0:10	
REQUIREMENTS	T00LS	Control console, SS computer, space crane, CCTV, robotics, test equipment		Control console, CCTV, robotics	Control console, SS computer, space crane, CCTV	Control console, SS computer, robotics, CCTV	Control console, SS computer, space crane, CCTV	Control console, SS computer, robotics, CCTV	Control console, SS computer	Control console, SS computer CCTV, robotics	
	FACILITIES	Space station berthing area, signal, power, propel-	11ghting								
	TASK	BERTHING AT SPACE STATION	BERTHING OPERATIONS	Inspect berthing cradle	Translate OTV to berthing cradle	Inspect OTV for damage	Position and latch OTV in berthing cradle	Connect umbilicals to OTV	Verify mechanical and selectrical umbilical connections	Install leak detection equipment	
SEQUENCE	NUMBER	6.2	6.2.1	6.2.1.1	6.2.2	6.2.3	6.2.4	6.2.5	6.2.6	6.2.7	- a

# GROUND-BASED OTV PRELAUNCH MISSION PROCESSING

Operations related to prelaunch mission processing of the Ground-Based OTV are provided.

# GBOTV MISSION PROCESSING



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#### GBOTY POSTMISSION PROCESSING

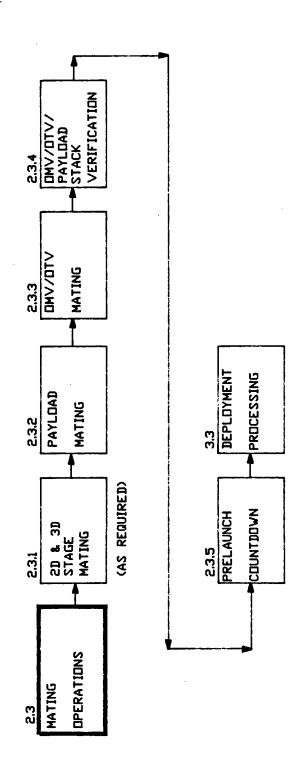
SHEET 1 of 1

	REMARKS									
MANITOTIRS	TOTAL	8:55			8:55	0:02	0:10	0:20		0:10
-	Ē									
CREW SUPPT	EVA	51			_ <del>2</del> i	_ <del>2</del>	<del>-</del>			-5-
CREW	1 1	8:55			8:55		0:10	0:50	8:00	0:10
PUNC	TIME	8:55			8:55	0:02	0:10	0:20	8:00	0:10
	TRNC								1+2	
REQUIREMENTS	TOOLS	Control console, SS computer,	effectors, test equipment			Control console, SS computer	  Control console, SS computer	Control console, SS computer	Control console, SS computer, software	Control console, SS computer
	FACILITIES	SS  berthing	area,	signal umbilicals lighting						
	TASK	MISSION PROCESSING			Systems Testing	Connect propellant umbilicals	Verify power levels	Verify signal transmission	Verify OTV systems	  Verify OTV safed
SEQUENCE	NUMBER	1.3			1.3.1	1.3.1.1	1.3.1.2	1.3.1.3	1.3.1.4	1.3.1.5

### GROUND-BASED OTV MATING OPERATIONS

Operations addressing the mating of the GBOTV with payloads, OMV, and other GBOTV stages are shown on the functional flow and following requirements definition set.

# GBOTV MATING OPERATIONS



GBOTV MISSION PROCESSING

SHEET 1 of 13

		on model
REMARKS		As required by mission model
MANIFOURS   EVA   TOTAL	15:00	15:00
CREW SUPPT	12:00	12:00
FUNC	15:00	15:00
TRNC		
REQUIREMENTS TOOLS	Control console, SS computer,	Control console, SS computer,
FACILITIES	SS berthing area, power, signal, propell-ant umbilicals space	
TASK	Mating Procedures	GBOTV 2d & 3d Stage Mating (as required) See G.1, G.2, 1.3 for specific procedures processing to lst stage
SEQUENCE NUMBER	2.3	2.3.1.1

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GBOTV MISSION PROCESSING

SEQUENCE			REQUIREMENTS		FUNC	CREW SUPPI	I MANHOURS	RS 1
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	IVA EVA	EVA TOTAL	AL REMARKS
2.3.2	Payload Mating				2:30	2:30		2:30
2.3.2.1	Logistics support available to support mating operations			· <u>'</u>	, - <del></del>			
2.3.2.2	Translate space crane to shuttle docking area		Control console, SS computer,	~	0:15	0:15		0:15   Payload removed from cargo bay w/shuttle RMS
2.3.2.3	Translate payload to berthing area		Control console, SS computer, CCTV, space crane	7	0:20	0:20	- <del></del> -	0:20
2.3.2.4	Position and secure payload in mating cradle		Control console, SS computer, CCTV, space crane	~	0:20	0:20		0:20
2.3.2.5	Connect power and signal umbilicals to payload		Control console, SS computer, CCIV, robotics	~	0:15	0:15	- <del></del> -	0:15
2.3.2.6	Verify mechanical/ electrical interfaces		Control console, SS computer		0:02	0:05		0:05
2.3.2.7	Verify OTV/payload alignment		Control console, SS computer,	7	0:15	0:15		0:15
2.3.2.8	Mate OTV/payload - verify proper electrical/mechanical		Control console, SS computer,	~	1:00	1:00   1:00		1:00

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TASK  OMV/OTV MATING  Translate OMV to OTV berthing area  Secure OMV to berthing cradle  Verify OMV/OTV alignment  Mate OMV with OTV - verify mechanical interfaces  Connect nower and sienal
TASK  OHV/OTV HATING  Translate OHV to area  Secure OHV to ber  Verify OHV/OTV all  mechanical interfi

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GBOTV MISSION PROCESSING

SEQUENCE			REQUIREMENTS		۴	FUNC	CREW SUPPT	_	MANIFOURS	IOURS		1
NUMBER	TASK	FACILITIES	TOOLS	T	TRNG TIME	ΙŦ	IVA	-	EVA   TOTAL	OTAL	REMARKS	
2.3.4	OMV/GBOTV/ Payload Stack Verification			<del></del>		0:30	0:30			0:30		
2.3.4.1	Verify all mechanical/ electrical connections		Control console, SS computer, CCTV	puter,		0:20	0:20			0:20		
2.3.4.2	Verify stack is ready to commence prelaunch count-down		Control console, SS computer	puter		0:10	- 0::0			0:10		
							<del></del>					

SHEET 5 of 13

GBOTV MISSION PROCESSING

SEQUENCE			REQUIREMENTS		FUNC	FUNC   CREW SUPPT   MANHOURS	12.	TANHOURS		1
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TRNG (TIME	IVA EVA	A   EV.	EVA   TOTAL	REMARKS	
2.3.5	Prelaunch Countdown									
2.3.5.1	Propellant Transfer		Control console, SS computer, leak detection equipment	·	4:05	4:05		4:05		
2.3.5.1.1	Verify leak detection equipment operational		Control console, SS computer	7	0:05	0:05		0:02		
2.3.5.1.2	Complete propellant transfer		Control console, SS computer	7	4:00	4:00		4:00	4:00  4:00 hrs/stage	
									•	

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SEQUENCE			REOUTREMENTS		FUNC	CREW SUPPT	PPT	MANHOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	1 1	IVA IR	EVA	EVA   TOTAL	REMARKS
2.3.5.2	AVIONICS MODULE TESTING			-	1:20	1:20		1:20	
2.3.5.2.1	  Verify OTV configuration		Control console, SS computer	- 7	0:15	0:15		0:15	
2.3.5.2.2	Load diagnostic checkout   program	_ <u>~</u>	Control console, SS computer, software	7	0:15	0:15		0:15	
2.3.5.2.3	Conduct diagnostic testing	_ <del>ii</del> _	SS computer		0:50	0:50   0:50		0:0	

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FACILITIES
Control console, SS computer
Control console, SS computer

#### SHEET 10 of 13

SEQUENCE			REQUIREMENTS		FUNC	CREW SU	PPT	FUNC   CREW SUPPT   MANIFOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNG	TIME	TRNG   TIME   IVA   EVA		EVA   TOTAL	REMARKS
2.3.5.6	Propellant System Check			-	0:20	0:20		0:20	
2.3.5.6.1	Verify leak check		Control console, SS computer	- 7	0:05	0:05		0:02	
2.3.5.6.2	Propellant subsystems operational		Control console, SS computer	7	0:15	0:15		0:15	
	<u> </u>								

SEQUENCE			REQUIREMENTS		PUNC CREW SUPPT   MANIIOURS	CREW S	I LIJAN	MAN	HOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TRNC   TIME   IVA   EVA   TOTAL	IVA	EVA	EVA	TOTAL	REMARKS
2.3.5.7	OTV BCS Check				0.30	0.30			0.30	
	TO TO THE TOTAL OF				3		-		3	
2.3.5.7.1	RCS system check		Control console, SS computer	7	0:15	0:15   0:15			0:15	
2.3.5.7.2	I Verify RCS propellant load		Control console, SS computer		0:15	0:15   0:15			0:15	

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SEQUENCE			REQUIREMENTS		FUNC CREW SUPPT	CREW S	UPPT	MANHOURS	1 s
NUMBER	TASK	FACILITIES	TOOLS	TRNC	TRNG TIME	IVA	EVA	EVA   TOTAL	L   REMARKS
2.3.5.8	Verify Health and Status of Payload				0:50	0:50	<del></del>	0:50	01
2.3.5.8.1	Verify OTV/payload mechanical/electrical interfaces		Control console, SS computer		0:15	0:15		0:15	
2.3.5.8.2	  Verify power/telemetry data		Control console, SS computer	7	0:20	0:20		0:20	
2.3.5.8.3	Verify payload ACS operating and propellant load		Control console, SS computer	7	0:15	0:15		0:15	- <del></del> -
						- <b>-</b>			

13
of
13
SHEET

SEQUENCE			REQUIREMENTS		FUNC	CREW SUP	FUNC   CREW SUPPT   MANIFOURS	
NUMBER	TASK	FACILITIES	TOOLS	TRING	TIME	IVA   EVA	L   EVA   TOTAL	REMARKS
2.3.5.9	OMV Health and Status				0:45	0:45	0:45	
2,3,5,9,1	Verify mechanical OMV/OTV		Control console, SS computer	7	0:10	0:10	0:10	
2.3.5.9.2	Verify power levels and telemetry data		Control console, SS computer		0:20	0:20	0:20	
2.3.5.9.3	Verify propellant loads		Control console, SS computer		0:15	0:15	0:15	

## GROUND-BASED OTV DEPLOYMENT

Top level functional flow and requirements definition are provided for deployment of the Ground-Based OTV, mated with a payload and the OMV, from Space Station.

#### DPERATIONS FLIGHT GBOTV DEPLOYMENT FROM SPACE STATION 3,3,3 DEPLDY STACK RELEASE STACK AND DEBERTH 3.3.2 TRANSLATE STACK TD DEPLOYMENT POSITION 3,3,1 DEPLOYMENT PRIICESSING

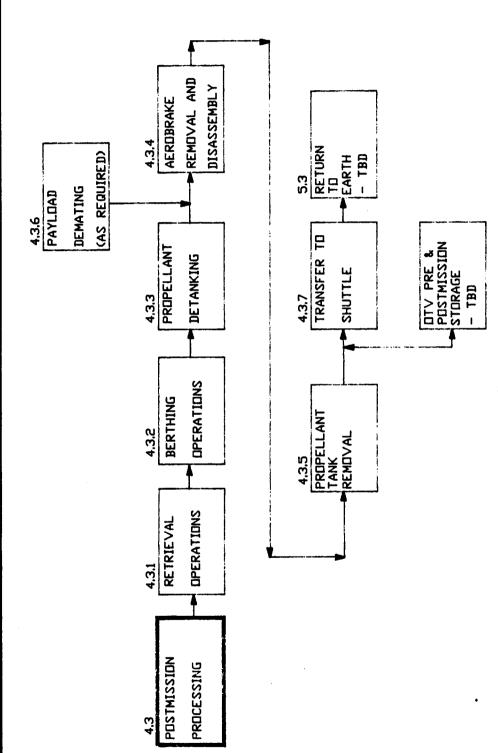
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SEQUENCE			REQUIREMENTS		FUNC	CREW SUPP	PT   MA	HOURS	
NUMBER	TASK	FACILITIES	T00LS	ITRIKE	TIME	ITVA TEV	T TEVA	TTOTAL	REMARKS
3.3	Deployment Processing				1:45	1:45		1:45	
3.3.1	Translate stack to deployment				1:10	1:10		1:10	
3.3.2	Release stack and deberth	· ·			0:30	0:30		0:30	
3.3.3	Deploy stack				0:02	0:02		0:05	
	-								

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# GROUND-BASED OTV POSTMISSION PROCESSING

The operations associated with retrieval of the GBOTV and OMV and, at times, a return payload, and the subsequent postmission processing operations are provided.



OTV POSTHISSION PROCESSING

		ORIGINAL PA			1.0		- 1:25/tank		; l ea structure	atus	
	REMARKS		  See G.1 for detalls 	  See G.2 for detalls 	  See 2.3.5.1 for details		  See 4.1 for details - 		  4 ea propollent tanks;  lea  aerobrake;  lea core struct	h and st	MARTIN MARIETTA
MANIFOLIDE	TOTAL	24:45	3:00	2:35	4:00	5:05	2:00	1:0	3:35		<b>V</b> I
F	[의			<del></del>							- NAR
Tagilly USAS	IVA EVA	24:45	3:00	2:35	4:00	5:05	5:00	1:00	3:35		\$
FIINC		24:45	3:00	2:35	4:00	5:05	2:08	8	3:35	,	_
	TRNC		~	~ ~ ~	- 5	~	~	~ ~			-
REOUTREMENTS		Control console, SS computer,  CCTV, tools/effectors, aero- e, brake disassembly tool 	Control console, SS computer, space crane, CCTV	Control console, SS computer, space crane, CCTV	Control console, SS computer	Control console, SS computer, CCTV, tools/effectors, aero-brake disassembly tool	Control console, SS Computer, CCIV, tools/effectors	Control console; SS computer, CCTV	Control console, SS computer, CCTV, space crane	Control console, SS computer	A-301
	FACILITIES	SS berthing structure, signal, power, propellent umbilicals space					-			E	ND
	TASK	Postmission Processing	Retrieval operations	Berthing at space station	Propellant detanking	Aerobrake removal and disassembly	Propellant tank removal	Payload demating	Transfer to shuttle	Storage awaiting shuttle	- DATE MAY 18, 1988
SEQUENCE	NUMBER	4.3	4.3.1	4.3.2	4.3.3	4.3.4	4.3.5	4.3.6	4.3.7	4.3.8	